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An Economic Reassessment of the Long Term Prospects for the UKCS: Can Vision 2035 Become a Reality?

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Research in North Sea Economics has been conducted in the Economics Department since 1973. The present and likely future effects of oil and gas developments on the Scottish economy formed the subject of a long term study undertaken for the Scottish Office. The final report of this study, The Economic Impact of North Sea Oil on Scotland, was published by HMSO in 1978. In more recent years further work has been done on the impact of oil on local economies and on the barriers to entry and characteristics of the supply companies in the offshore oil industry.

The second and longer lasting theme of research has been an analysis of licensing and fiscal regimes applied to petroleum exploitation. Work in this field was initially financed by a major firm of accountants, by British Petroleum, and subsequently by the Shell Grants Committee. Much of this work has involved analysis of fiscal systems in other oil producing countries including Australia, Canada, the United States, Indonesia, Egypt, Nigeria and Malaysia. Because of the continuing interest in the UK fiscal system many papers have been produced on the effects of this regime.

From 1985 to 1987 the Economic and Social Science Research Council financed research on the relationship between oil companies and Governments in the UK, Norway, Denmark and The Netherlands. A main part of this work involved the construction of Monte Carlo simulation models which have been employed to measure the extents to which fiscal systems share in exploration and development risks.

Over the last few years the research has examined the many evolving economic issues generally relating to petroleum investment and related fiscal and regulatory matters. Subjects researched include the economics of incremental investments in mature oil fields, economic aspects of the CRINE initiative, economics of gas developments and contracts in the new market situation, economic and tax aspects of tariffing, economics of infrastructure cost sharing, the effects of comparative petroleum fiscal systems on incentives to develop fields and undertake new exploration, the oil price responsiveness of the UK petroleum tax system, and the economics of decommissioning, mothballing and re-use of facilities. This work has been financed by a group of oil companies and Scottish Enterprise, Energy. The work on CO2 Capture, EOR and storage was financed by a grant from the Natural Environmental Research Council (NERC) in the period 2005 – 2008.

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OP 143 An Economic Reassessment of the Long Term Prospects for the UKCS: Can Vision 2035 Become a Reality?
BY A G Kemp and Linda Stephen (October 2018) pp. 73

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Professor Alexander G. Kemp and Linda Stephen

Contents Page

1. Introduction and Context……………………………….……………1
2. Methodology and Data…………………………………………….....2
3. Results…………….…………………………………………….…10
   a) Numbers of Fields in Production…….…......………………...10
   b) Potential Production…………….……………………………13
   c) Potential Development Expenditure………………………….26
   d) Potential Operating Expenditure……………………………...30
   e) Potential Development plus Operating Expenditures………...34
   f) Potential Decommissioning Activity...……………………….36
   g) Potential Total Field Expenditures……………………………44
4. Summary and Conclusions…………………………………47
APPENDIX
a) Potential Production……………………………………………...54
b) Potential Development Expenditure……………………………..62
c) Potential Operating Expenditure…………………………………64
d) Potential Decommissioning Activity…………………………….67

An Economic Reassessment of the Long Term Prospects for the UKCS: Can Vision 2035 Become a Reality?

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1. Introduction and Context

Following the oil price collapse in the latter part of 2014 activity in the UKCS has experienced a very painful decline, particularly with respect to field investment expenditures, but also to operating costs. Exploration and appraisal activities have also continued at historically low levels, though it should be emphasised that these preceded the oil price collapse.

Since 2014 the industry has responded by effecting very painful reductions in unit investment and operating costs. OGUK has found that average development costs for all of the UKCS have fallen from a high of $23.8 per boe in 2014 to $11.8 in 2017 with an estimate of $13 - $15 per boe for 2018. For operating costs OGUK's estimates for 2014 are $29.6 per boe, $15.2 per boe in 2017, and $15.8 - $16.4 per boe for 2018. Very recently the OGA published data on production and revenue in the UKCS. These show that average operating costs across the province have fallen from $32.0/boe in 2014, to $23.2/boe in 2015, $15.7/boe in 2016, and $15.0/boe in 2017. A further major change over the past few years has been a big increase in production efficiency. From a low of 61% in 2012, there has been a major improvement to 74% in 2017 according to OGA data. A yet further major change has been the divestment of a substantial number of assets by established players and their purchase by new players, in many cases backed by private equity companies. A further major change to the operating environment has been a substantial increase in oil and gas prices in recent months. Further, the OGA, the new regulator, has become increasingly active in promoting MER. In addition both the OGTC and OGIC have become very active in encouraging productivity enhancements in the sector.

Given all the above a reassessment of the prospects for longer term activity is opportune. The OGA has indicated a central estimate of cumulative production to 2050 of 11.7 billion boe (bn boe). This corresponds closely to the near 11 bn boe by 2050 projected by the present authors in early 2017. The OGA also postulates in Vision 2035 cumulative production of 14.9 bn boe by 2050.

The present study constitutes a major revision of the prospects reflecting in particular the cost reductions achieved in recent years, and upward revisions to the numbers of undeveloped discoveries in the category of technical reserves (i.e. fields not currently being examined for development). In addition it is assumed that any unit cost increases can be held in check, including by productivity gains from the implementation of technological advances. Nominal costs are assumed to increase in line with oil and gas prices. Low levels of exploration effort are assumed to continue.

2. Methodology and Data

The projections of production and expenditures have been made through the use of financial simulation modelling, including the use of the Monte Carlo technique, informed by large field databases validated to a large extent by the relevant operators, and from other sources. One field database incorporates key, best estimate information on production, and investment, operating and decommissioning expenditures. These refer to 400 sanctioned fields, 90 incremental projects relating to these fields, 14 probable fields, and 5 possible fields. The unsanctioned fields are currently being examined for development. A further database contains 408 fields defined as being in the category of technical reserves. This has been sourced from a combination of public and private sources. The coverage is now much more comprehensive compared to previous studies. Only summary data on reserves (oil/gas/condensate) and block locations are available for these. They are not currently being examined for development by licensees.

Monte Carlo modelling was employed to estimate the possible numbers of new discoveries in the period to 2049. The modelling incorporated assumptions based on recent trends relating to exploration effort, success rates, sizes, and types of discovery (oil, gas, condensate). A moving average of the behaviour of these variables over the past 5 years was calculated separately for 5 areas of the UKCS (Southern North Sea (SNS), Central North Sea/Moray Firth (CNS/MF), Northern North Sea (NNS), West of Shetlands (WoS), and Irish Sea (IS)). The results were employed for use by the Monte Carlo analysis. Because of the very limited data for WoS and IS over the period judgemental assumptions on success rates and average sizes of discoveries were made for the purposes of modelling.

It is postulated that the exploration effort depends substantially on a combination of (a) the expected success rate, (b) the likely size of discovery, and (c) oil/gas prices. In the present study 2 future oil/gas price scenarios were employed as follows:

Table 1

Future Oil and Gas Price Scenarios

	Oil Price (real) $/bbl	Gas Price (real) pence/therm
Medium	60	55
High	70	60

These price scenarios are designed to reflect investment screening prices, not market values. In MOD terms the price scenario starting with $60 in 2018 becomes $113 in 2050, and the scenario starting with $70 in 2018 becomes $132 in 2050. The exchange rate employed was £1 = $1.31685 which was the rate when the modelling commenced. The structure of costs between dollars and sterling in the modelling reflects the recent position.

The postulated numbers of annual exploration wells drilled for the whole of the UKCS are as follows for 2018, 2030, 2040, and 2045:

Table 2
Exploration Wells Drilled

	2018	2030	2040	2045
Medium Oil Price = Low Effort	14	12	10	9
High Oil Price = Medium Effort	20	17	15	13

It is postulated that success rates depend substantially on a combination of (a) recent experience, and (b) size of the effort. It is further suggested that higher effort is associated with more discoveries, but with lower success rates compared to lower levels of effort. This reflects the view that low levels of effort will be concentrated on the lowest risk prospects, and thus higher effort involves the acceptance of higher risk. For the UKCS as a whole, 2 success rates were postulated as follows with the lower one reflecting the average over the past 5 years.

Table 3 Success Rates for UKCS	
Low effort/Higher success rate	32.47%
Medium effort/Lower success rate	26.47%

It should be noted that success rates have varied considerably across the 5 sectors of the UKCS. This has been incorporated into the modelling. The annual number of discoveries has been low since 2010 which is not surprising, given the large decline in the number of exploration wells since 2008. It is assumed that technological progress will maintain historic success rates over the time period.

The mean sizes of discoveries made in the historic periods for each of the 5 regions were calculated. It was assumed that the mean size of discovery would decrease in line with recent historic experience. They are shown in Table 4.

Table 4 Mean Discovery Size MMboe		
Year	**2018**	**2045**
SNS	**28**	**21**
CNS/MF	**32**	**24**
NNS	**21**	**16**
WoS	**70**	**52**
IS	**12**	**8**

For purposes of the Monte Carlo modelling of the size of new discoveries the standard deviation (SD) was set at 50% of the mean value. In line with historic experience the size distribution of discoveries was taken to be lognormal.

Using the above information, the Monte Carlo technique was employed to project discoveries in the 5 regions to 2049. For the whole period the total numbers of discoveries for the all of the UKCS were as follows:

Table 5 **Total Number of Discoveries to 2050**	
Medium Effort/Lower success rate	137
Low Effort/Higher Success Rate	112

For each region the average development costs (per boe) of fields in the probable and possible categories were calculated. These reflect the cost reductions over recent years. Investment costs per boe depend on several factors including not only the absolute costs in different operating conditions (such as water depth) but on the size of the fields. For all of the UKCS the recent average development cost was $11 per boe with the highest being $31. In the SNS development costs were found to average $10.52 per boe. In the CNS/MF, they averaged $13.96 per boe, in the WoS they were $15 per boe (reflecting the relatively large size of fields), and in the NNS they averaged $15.29 per boe. Operating costs over the lifetime of the fields were also calculated. The average has fallen from $19 per boe to $10 for all of the UKCS. They are now at $6.86 per boe in the SNS, $10.41 per boe in the CNS/MF, $10 per boe in the WoS, and $10.3 per boe in the NNS. Total lifetime field costs (including decommissioning but excluding E and A costs) were found to have fallen from an average of $27.13 per boe for all of the

UKCS to $17.9 per boe, with $16 per boe in the SNS, $9.3 per boe in the CNS/MF, and $17.2 per boe in the WoS (reflecting the relatively large size of fields), and $26 per boe in the NNS.

Using these as the mean values the Monte Carlo technique was employed to calculate the development costs of new discoveries. A normal distribution with a SD = 20% of the mean was employed. For these fields annual operating costs were modelled as a percentage of accumulated development costs. This percentage varied according to field size. It was taken to increase as the size of the field was reduced, reflecting the presence of economies of scale. Thus the field lifetime costs in very small fields could become very high on a boe basis.

With respect to fields in the category of technical reserves it was recognised that major challenges exist, and so the mean development costs in each region of the UKCS was set at $5/boe higher than the mean for the new discoveries in that region. Thus, for the CNS/MF the mean development costs are $18.96 per boe, and in NNS over $20 per boe. The distribution of these costs was assumed to be normal with a SD = 20% of the mean value. A binomial distribution was employed to find the order of development of new fields in this category.

The annual numbers of new field developments were assumed to be constrained by the physical and financial capacity of the industry. The ceilings were assumed to be linked to the oil/gas price scenarios with maxima of 18 and 15 respectively for the High and Low price cases. These constrains do not apply to incremental projects which are additional to new field developments.

There is a wide range in the development and operating costs of the set of incremental projects currently being examined for development. For all of the UKCS the mean development costs are $12.63 per boe, but the highest is over

$200 per boe. In the SNS the average development costs are $4.7 per boe, but in the NNS it is $28.71 per boe. While operating costs average $10.18 per boe across all of the UKCS, there are 31 with $0 opex per boe.

A noteworthy feature of the 90 incremental projects in the database is the expectation that the great majority will be executed over the next 3 or 4 years. It is virtually certain that in the medium and longer-term many further incremental projects will be designed and executed. They are just not yet at the serious planning stage. Such projects can be expected to be linked not only to currently sanctioned fields, but also to those presently classified in the categories of probable, possible, technical reserves, and future discoveries.

Accordingly, estimates were made of the potential extra incremental projects from all these sources. Examination of the numbers of such projects and their key characteristics (reserves and costs) being examined by operators over the past 6 years indicated a decline rate in the volumes. Based on this and utilising the information of the key characteristics of the projects in the database, it was felt that, with a decline rate reflecting historic experience, further portfolios of incremental projects could reasonably be expected. As noted above such future projects would be spread over all categories of host fields. Their sizes and costs reflect recent trends.

With respect to investment decision making and project screening criteria oil companies (even medium-sized and smaller ones) currently assess their opportunities in the UKCS in comparison to those available in other parts of the world. Capital is allocated on this basis with the UKCS having to compete for funds against the opportunities in other provinces. A problem with the growing maturity of the UKCS is the relatively small average field size and the high unit costs. Mean discovery sizes are shown in Table 4 but, given the lognormal distributions, the most likely sizes are below these averages. It follows that the materiality of returns, expressed in terms of net present values (NPVs), is quite low in relation to those in prospect in other provinces (such as offshore Angola or Brazil, for example). Oil companies frequently rank investment projects according to the NPV/I ratio. Accordingly, this screening method has been adopted in the present study. Specifically, the numerator is the post-tax NPV at 10% discount rate in real terms, and the denominator is the pre-tax field investment, again at 10% discount rate in real terms. In the central scenario the development project goes ahead when the NPV/I ratio as defined above ≥ 0.3. Summary results are also shown to the Appendix when the investment hurdle is tougher at NPV/I > 0.5. The modelling has been undertaken under the current tax system. It is assumed that already sanctioned fields and incremental projects can use tax allowances immediately, but probable and possible fields, technical reserves, and new discoveries must generate taxable income from the new projects before they can use tax allowances. Thus, the Ring Fence Expenditure Supplement (RFES) is employed. The modelling is initially undertaken in MOD terms with an inflation rate of 2%. The results are then converted to real terms.

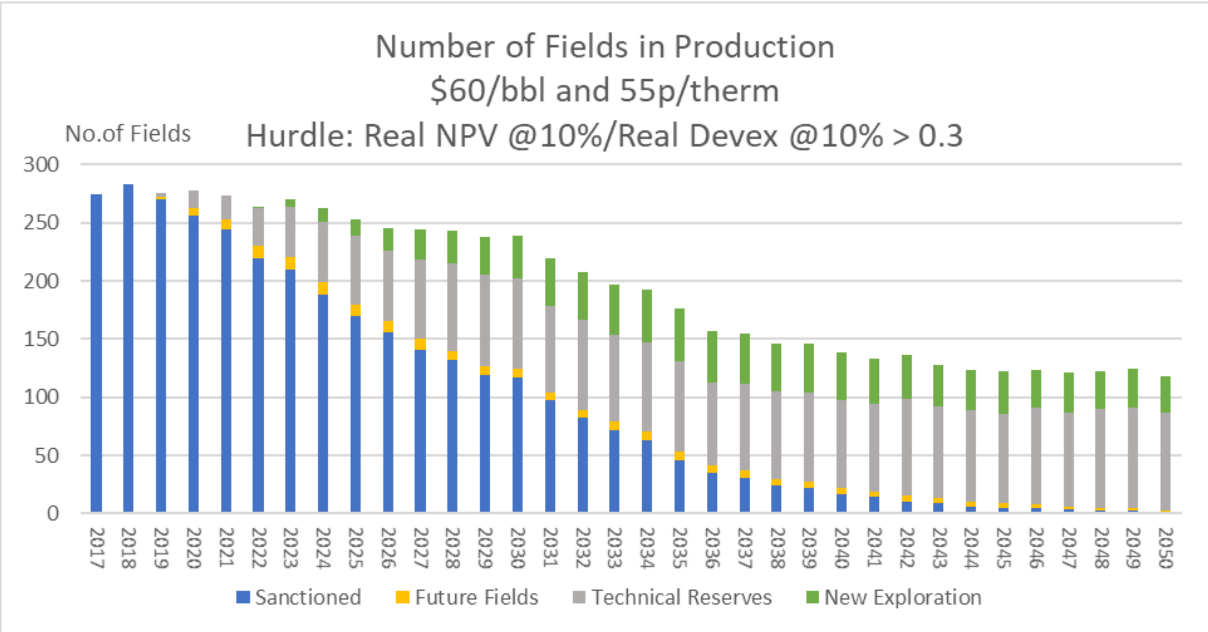
In the light of experience over the past few years some rephasing of the timing of the commencement dates of new field developments and incremental projects from those projected by operators was undertaken relating to the probability that the project would go ahead. Where the operator indicated that a new field development had a probability ≥ 80% of going ahead the date was left unchanged. Where the probability was ≥ 70% <80% the commencement date was slipped by 1 year, and where the probability was ≥ 50% < 70% the commencement date was slipped by 2 years. Where the probability was ≥ 40% < 50% the date was slipped by 3 years, and where the probability was ≥ 30% < 40% the date was slipped by 4 years. Where the probability was ≥ 20% < 30% it was slipped by 5 years, and where the probability was < 20% it was slipped by 6 years. If an incremental project had a probability of proceeding ≥ 70% the date was retained. Where it was ≥ 30% < 70% it was slipped by 1 year, and where it was < 30% it was slipped by 2 years.

3. Results

(a) Numbers of Fields in Production

In Chart 1 the numbers of producing fields are shown at the $60, 55 pence price scenario.

Chart 1

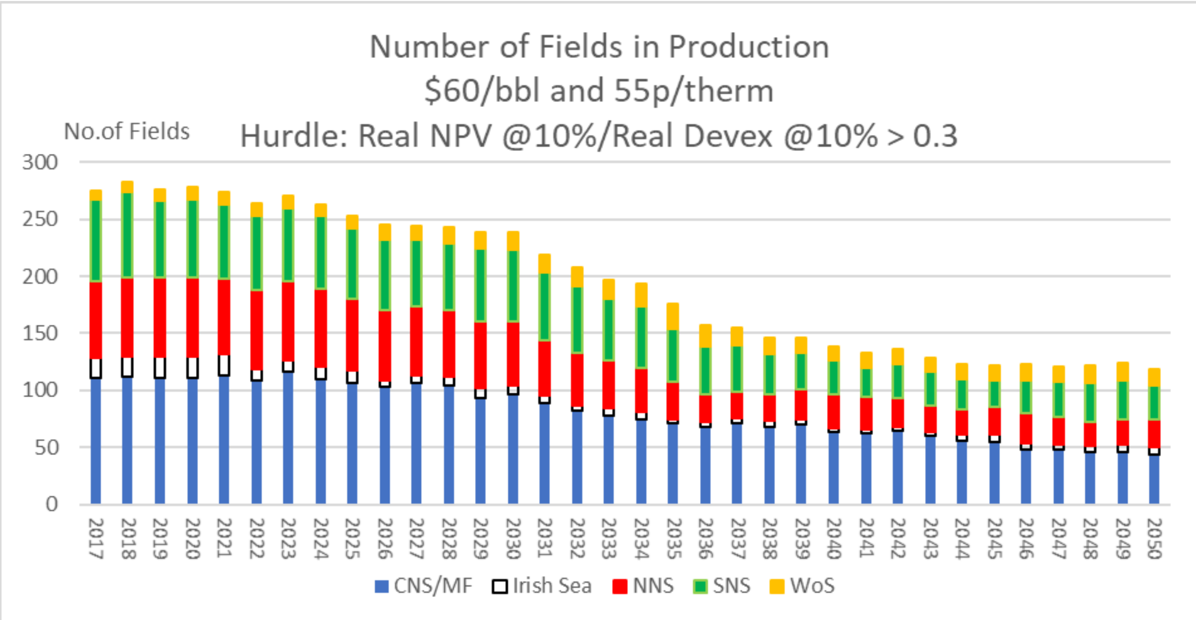


The numbers decline steadily over the period falling to less than 50 after 2035 for the currently producing fields. Over the period there are 421 new field developments triggered, of which 6 are in the sanctioned category, 13 are in the probable category, 1 in the possible category, 295 in the category of technical reserves, and 106 are future discoveries. With the $60 case and a 0.3 hurdle there are 70 fields which fail the hurdle rate, 5 of which are probable or possible fields, 63 are technical reserves, and 2 are new discoveries. There are also 14 incremental projects which fail the hurdle.

The pace of development of fields in the category of technical reserves is clearly ambitious and exceeds that achieved in recent years. The cost reductions recently achieved plus the enhanced collaboration among investors via the efforts of the OGA, and the productivity gains through technological progress facilitated by the OGTC are necessary to achieve the long-term pace of development found from the modelling. The physical capacity of the supply chain should be adequate to meet the demands of the new developments. Many are very small in scale.

In Chart 2 the numbers of producing fields by area are shown at the $60, 55 pence price scenario.

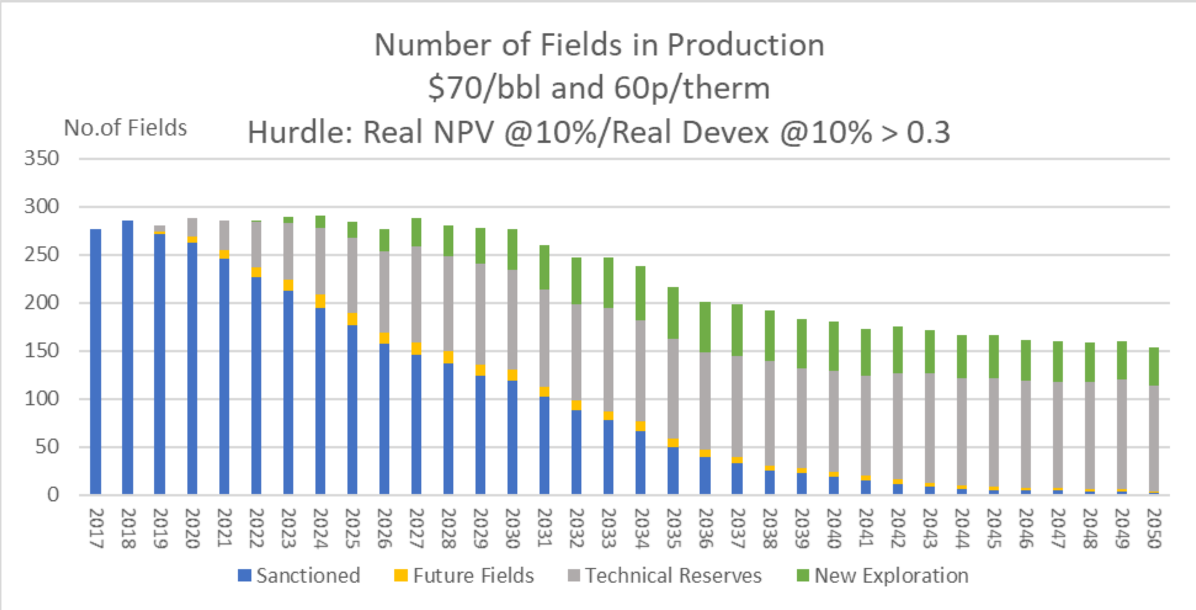
Chart 2



Of the 421 new field developments triggered, 168 are in the CNS/MF area, 18 are in the Irish Sea, 88 are in the NNS, 119 are in the SNS, and 28 are in the WoS area. Of the 70 fields which fail the hurdle rate, 30 are in the CNS/MF area, 21 are in the NNS, 6 are in the SNS, and 13 are in the WoS area.

In Chart 3 the numbers of fields in production are shown at the $70, 60 pence price scenario.

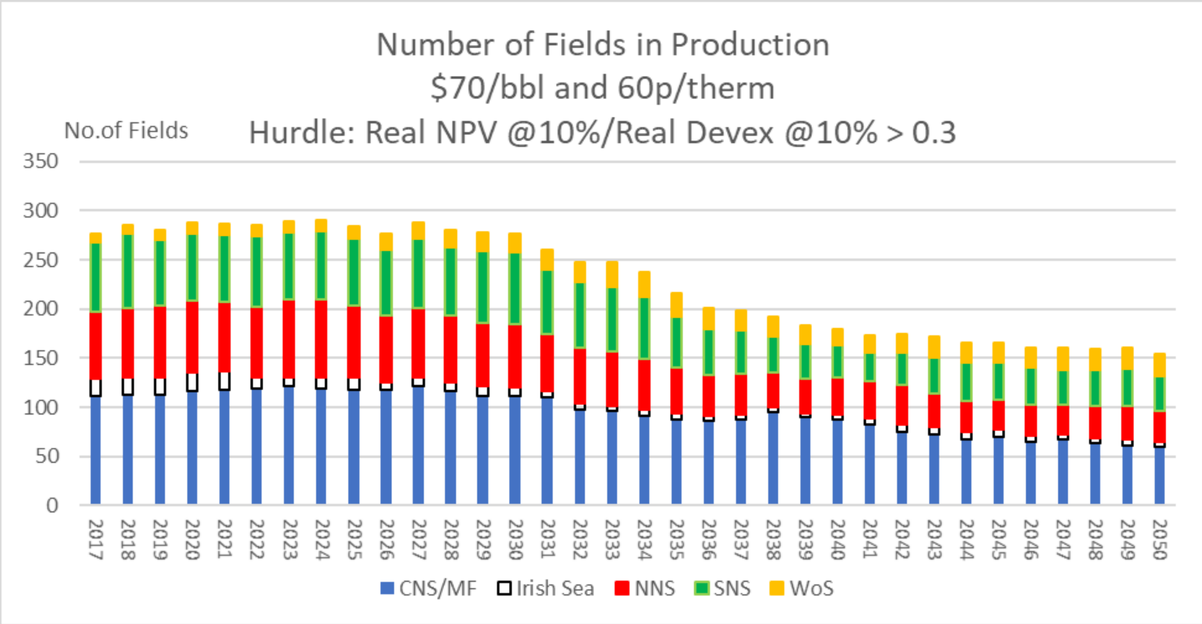
Chart 3



The numbers of producing fields decline steadily over the period falling to less than 50 after 2035 for the currently producing ones. Over the period there are 529 new field developments, of which 6 are in the sanctioned category, 14 are in the probable category, 4 in the possible category, 376 in the category of technical reserves, and 129 are future new discoveries. There are 34 fields which fail the hurdle rate, 1 of which is a possible field, 32 are technical reserves, and 1 is a new discovery.

In Chart 4 the numbers of producing fields are shown by area at the $70, 60 pence price scenario.

Chart 4

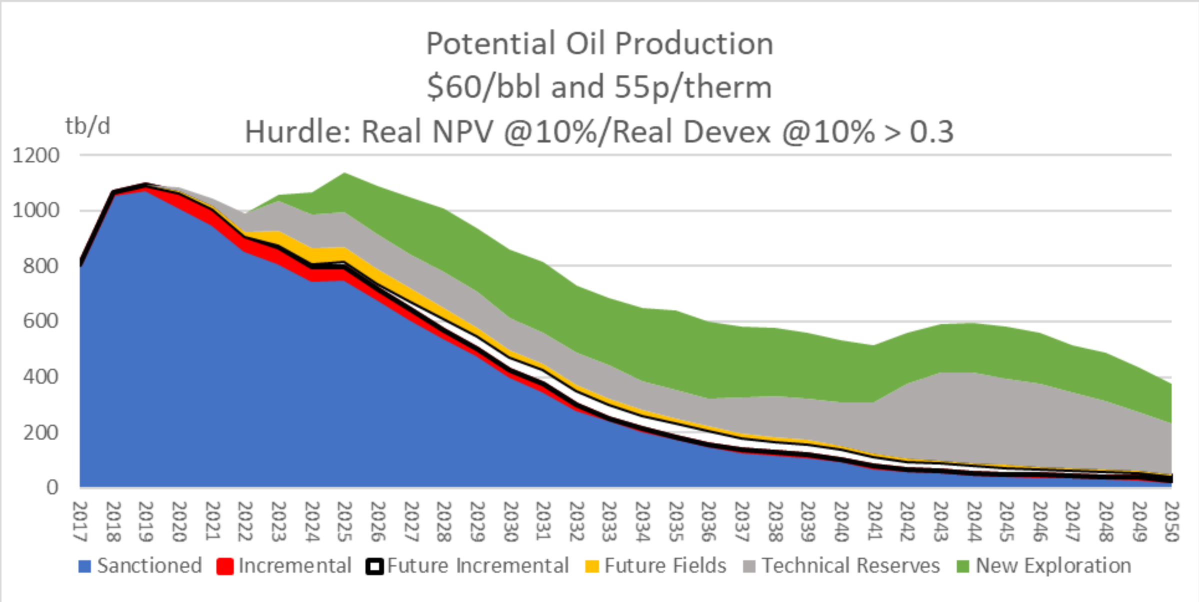


Of the 529 new field developments 208 are in the CNS/MF area, 21 are in the Irish Sea, 119 are in the NNS, 132 are in the SNS, and 49 are in the WoS area. There are 34 fields which fail the hurdle rate, 15 of which are in the CNS/MF area, 8 in the NNS, 3 in the SNS and 8 in the WoS area.

b) Potential Production

In Chart 5 potential oil production over the period 2018 to 2050 is shown for the $60, 55 pence case.

Chart 5



Over the period cumulative oil production is 9,148 million barrels of which 4,539 million comes from sanctioned fields, 177 million from current incremental projects, 361 million from future incremental projects, 215 million from probable and possible fields, 1,796 million from technical reserves, and 2,059 million from future discoveries.

The near term increase in oil production is not consistent with the recent projections made by the OGA. In the present study this reflects over-optimistic estimates made by the industry and, for the period from 2022 the effect of some investments not yet planned but which are likely to be economically and commercially viable.

In Chart 5a prospective oil production is shown in the historic context of production to date.

Chart 5a

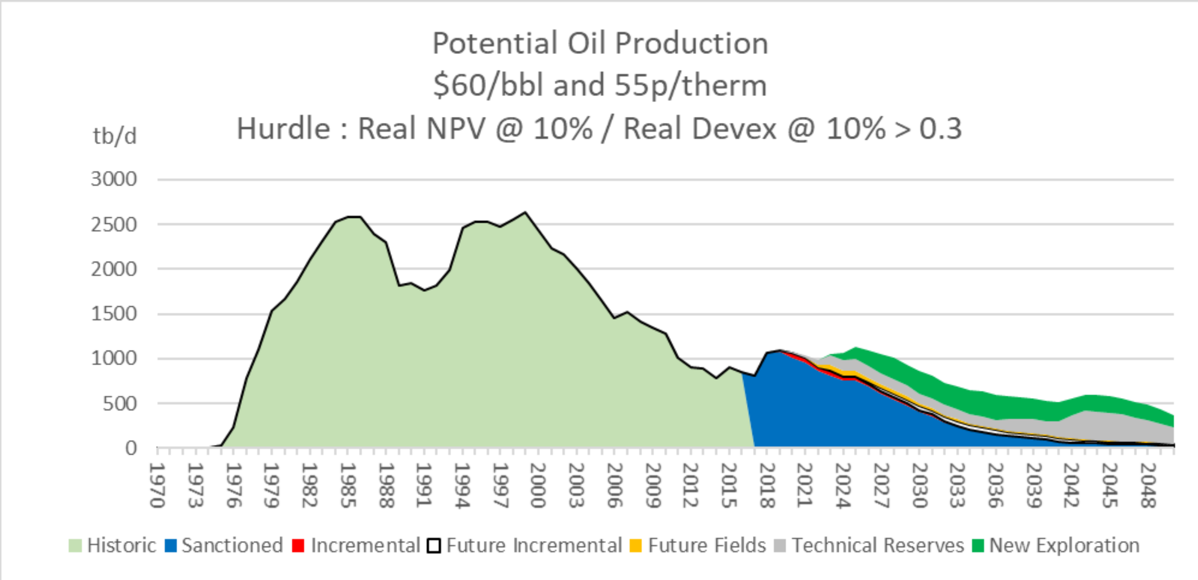
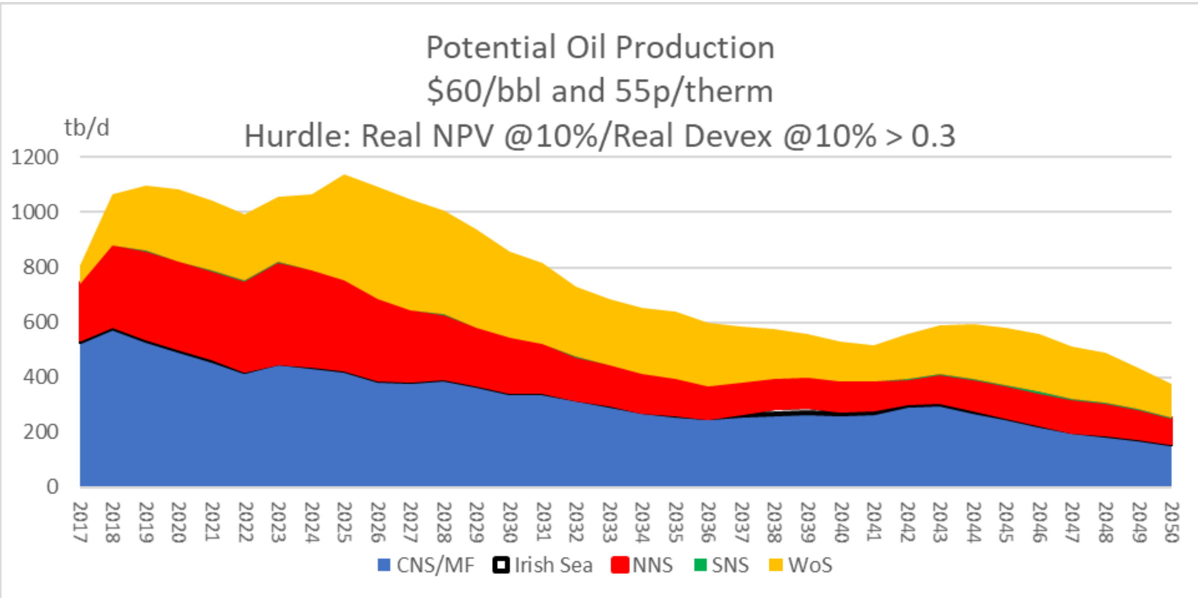


Chart 6 shows future oil production on a geographic basis.

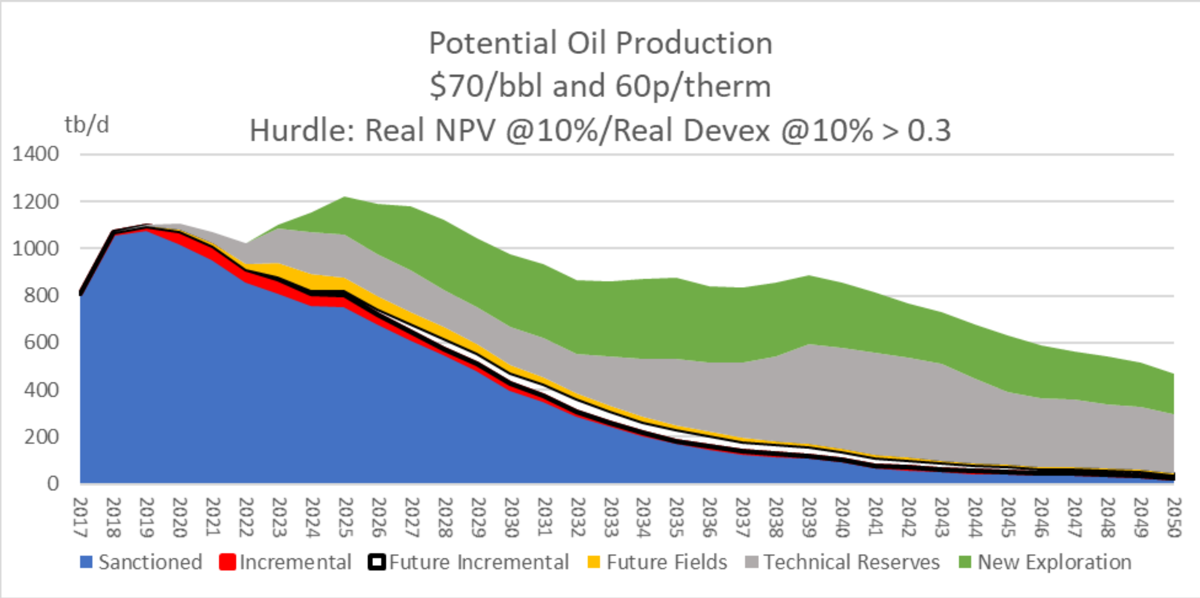
Chart 6



It is seen that 3,975 million barrels come from the CNS/MF area, 2,868 million barrels coming from WoS, and 2,198 million barrels from the NNS.

In Chart 7 potential oil production over the period 2018 to 2050 is shown for the $70, 60 pence case.

Chart 7



Over the period cumulative oil production is just under 10,700 million barrels of which 4,580 million come from sanctioned fields, 172 million from current incremental projects, 353 million from future incremental projects, 240 million from probable and possible fields, 2,810 million from technical reserves, and 2,545 million from future discoveries.

In Chart 7a prospective oil production is shown in the historic context of production to date.

Chart 7a

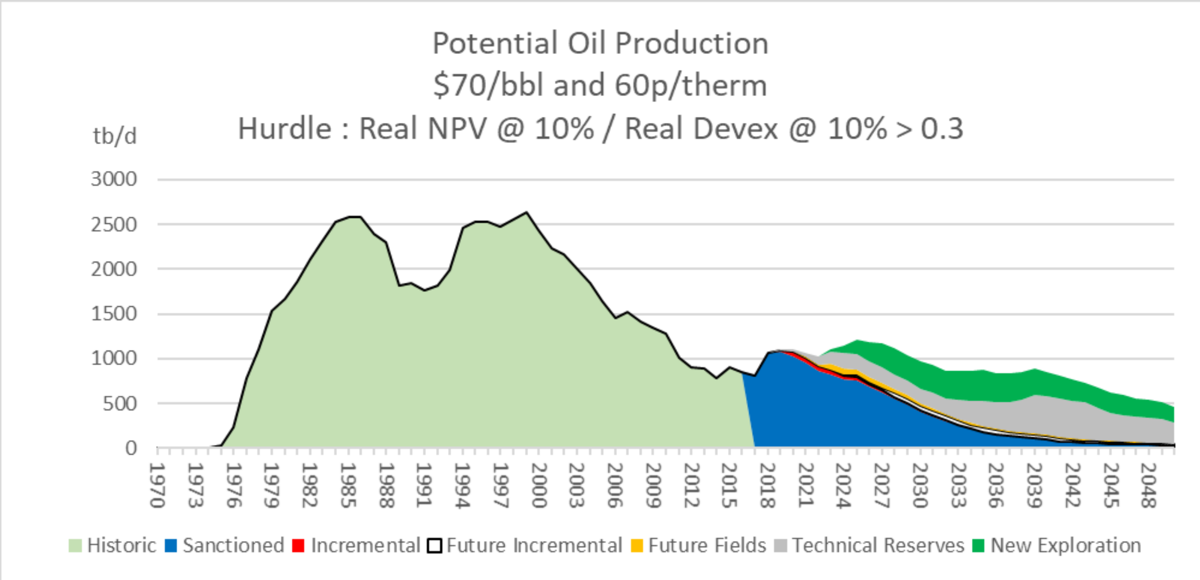
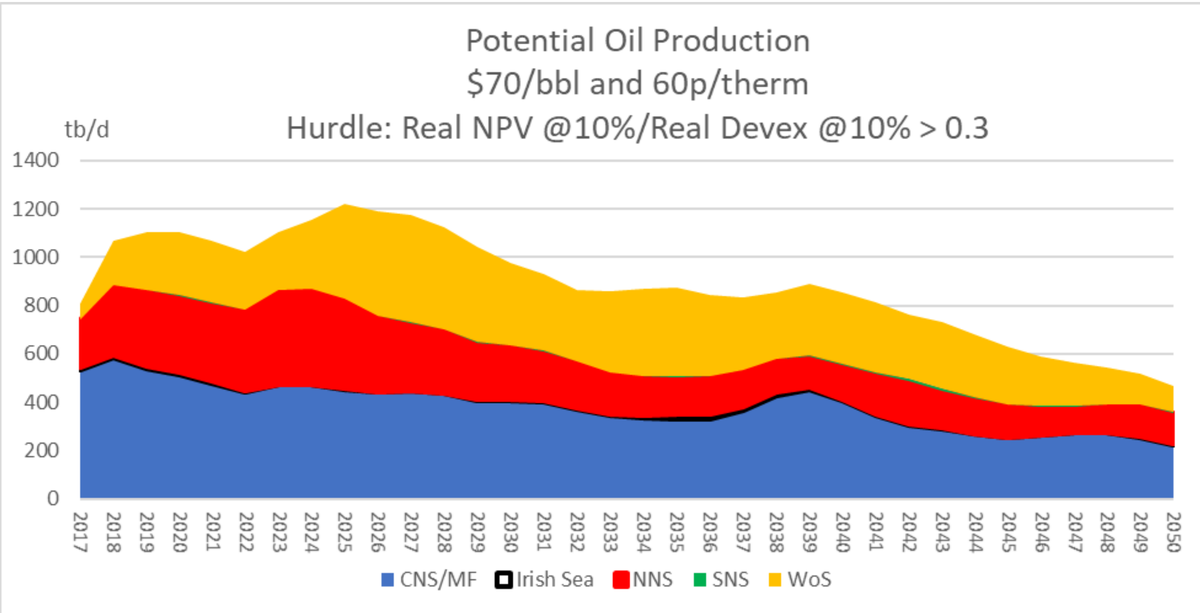


Chart 8 shows future oil production on a geographic basis.

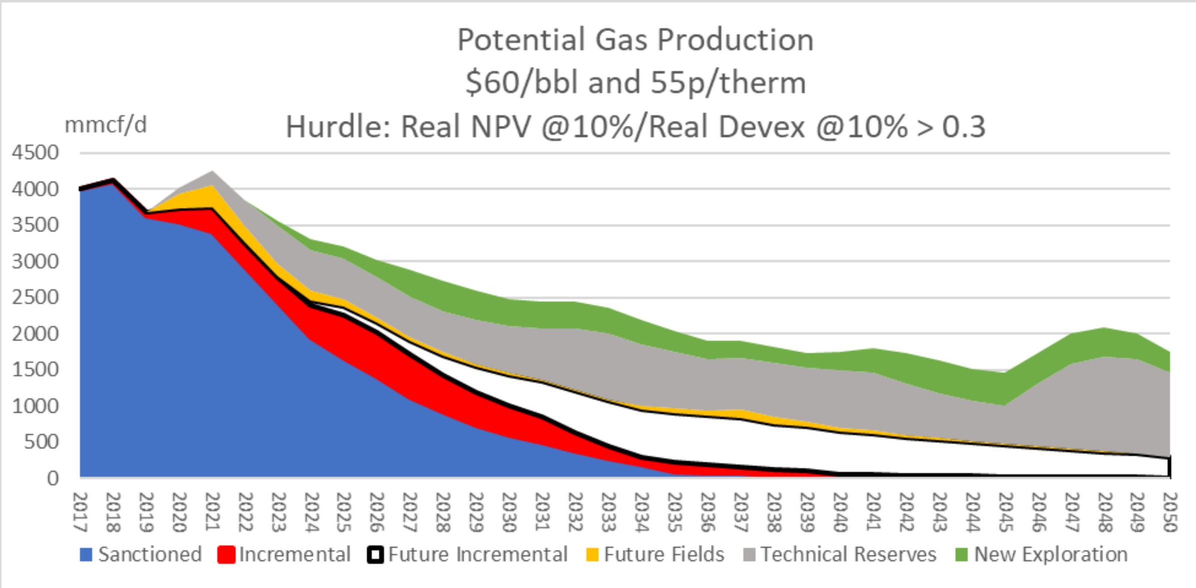
Chart 8



It is seen that 4,593 million barrels come from the CNS/MF area, followed by 3,431 million barrels from the WoS, and 2,563 million barrels from the NNS.

In Chart 9 potential gas production over the period 2018 to 2050 is shown for the $60, 55 pence case.

Chart 9



Over the period cumulative gas production is just under 5,337 million barrels of oil equivalent, of which 1,963 mmboe come from sanctioned fields, 419 mmboe from current incremental projects, 780 mmboe from future incremental projects, 142 mmboe from probable and possible fields, 1,438 mmboe from technical reserves, and 594 mmboe from future discoveries.

In Chart 9a prospective gas production is shown in the historic context of production to date.

Chart 9a

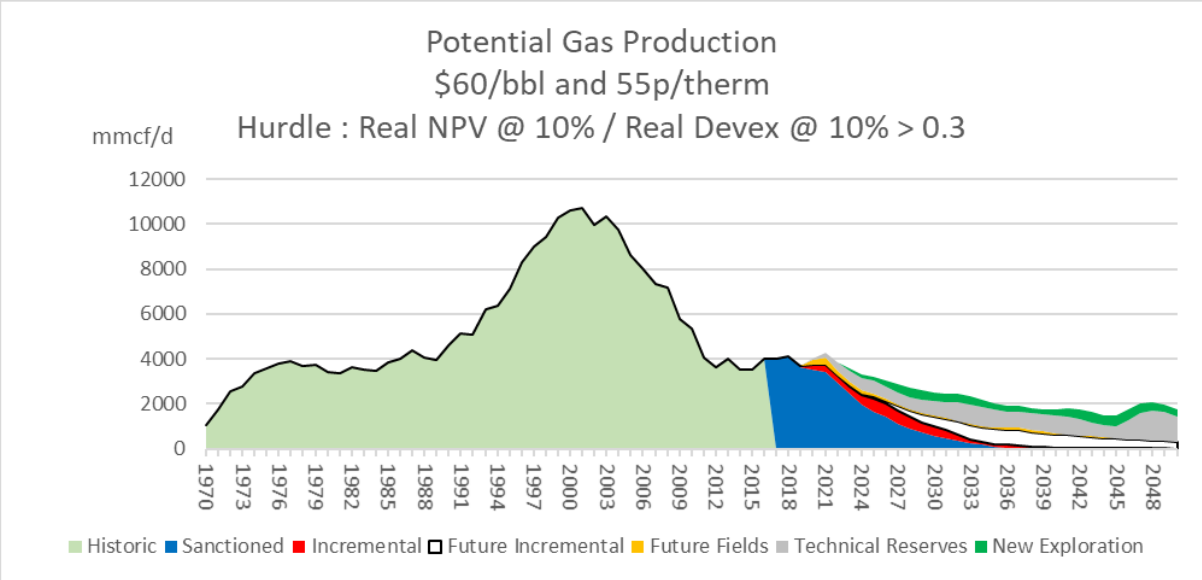
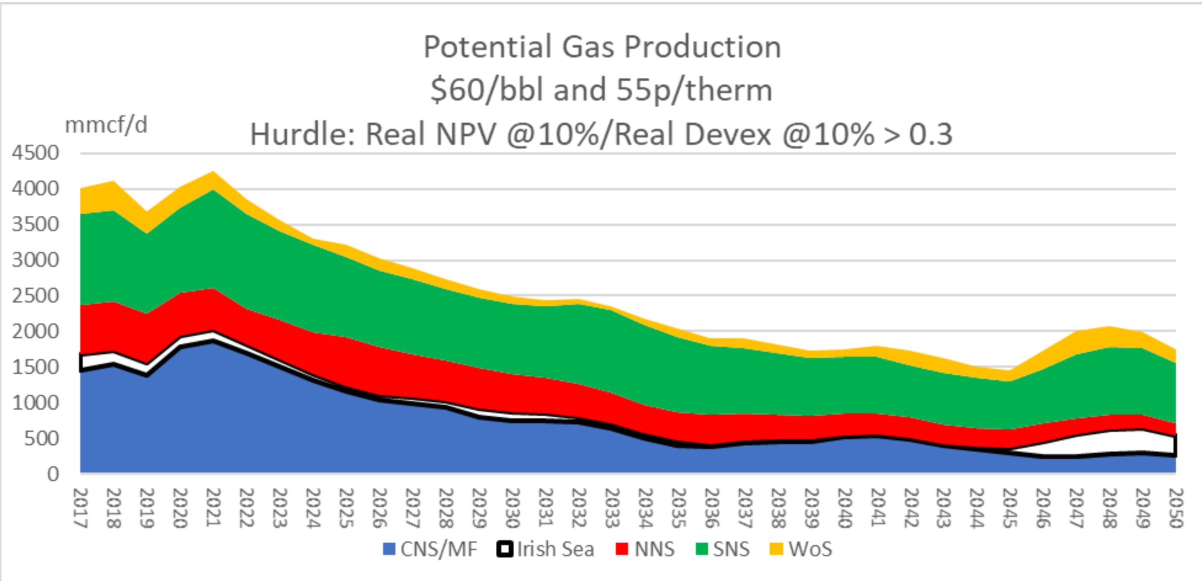


Chart 10 shows future gas production on a geographic basis.

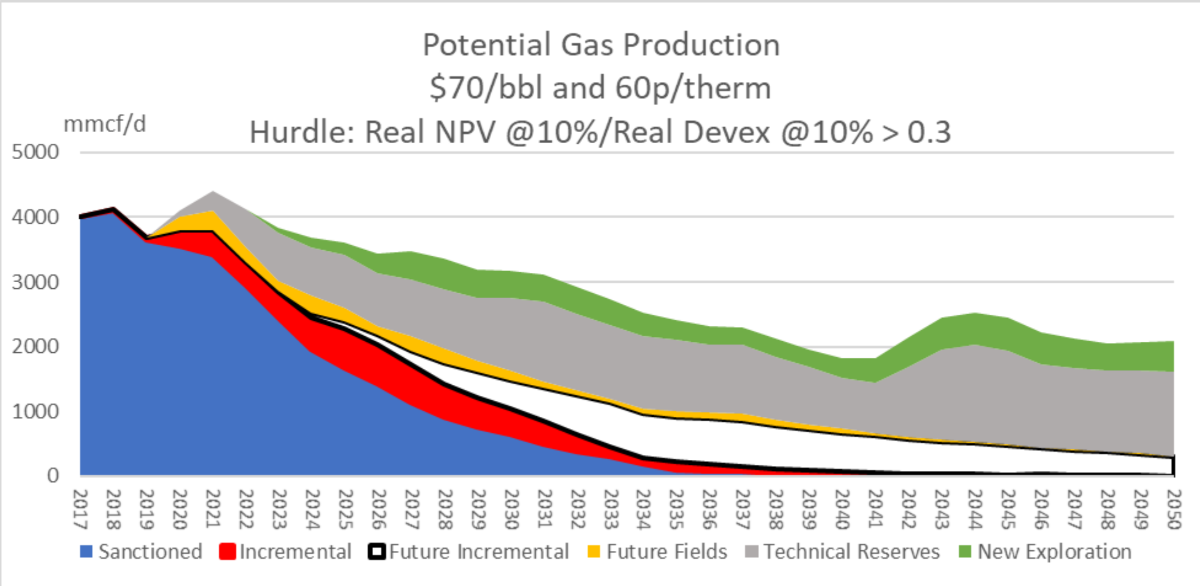
Chart 10



It is seen that 2,136 mmboe come from the SNS area, 1,656 mmboe come from the CNS/MF area, 930 mmboe from the NNS, 373 mmboe from the WoS area, and 242 million barrels coming from the Irish Sea.

In Chart 11 potential gas production over the period 2018 to 2050 is shown for the $70, 60 pence case.

Chart 11



Over the period cumulative gas production is just over 6,140 million barrels of oil equivalent, of which 1,972 mmboe come from sanctioned fields, 434 mmboe from current incremental projects, 813 mmboe from future incremental projects, 218 mmboe from probable and possible fields, 2,023 mmboe from technical reserves, and 680 mmboe from future discoveries.

In Chart 11a prospective gas production is shown in the historic context of production to date.

Chart 11a

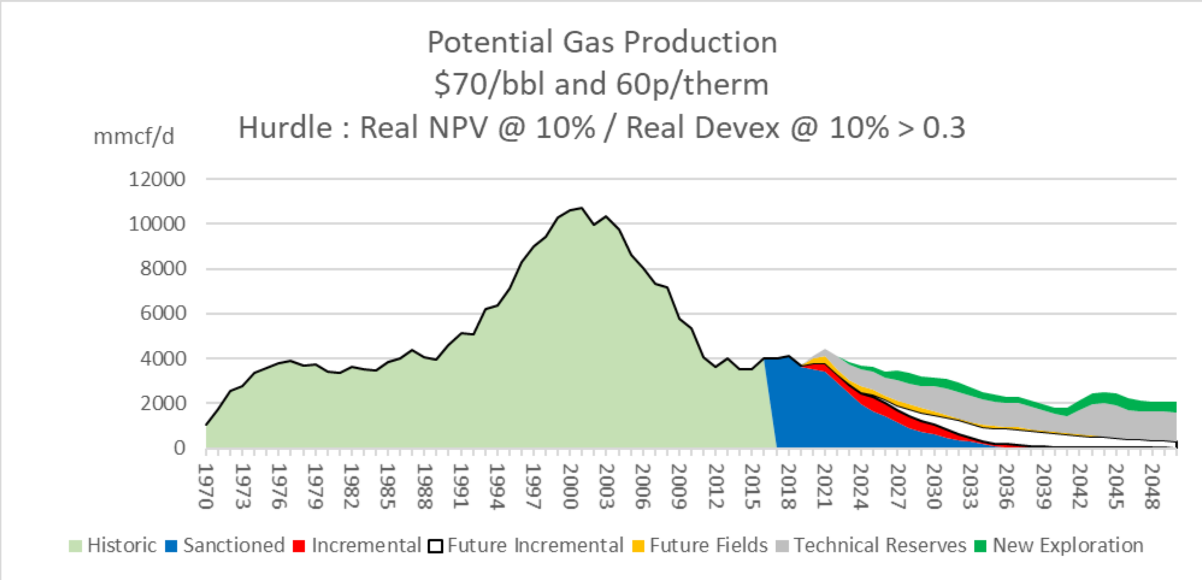
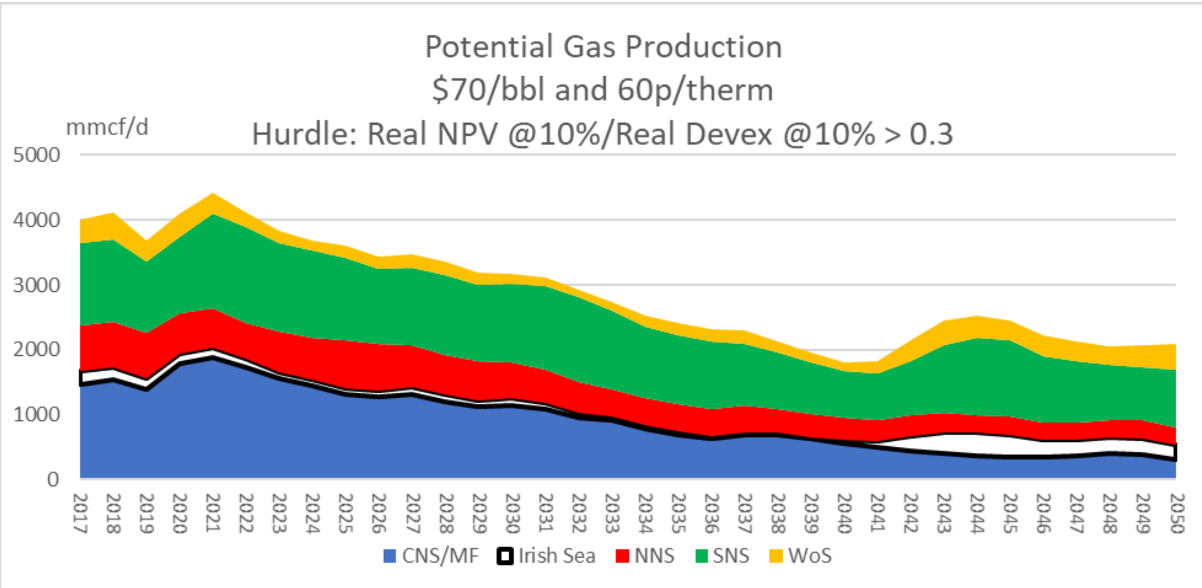


Chart 12 shows future gas production on a geographic basis.

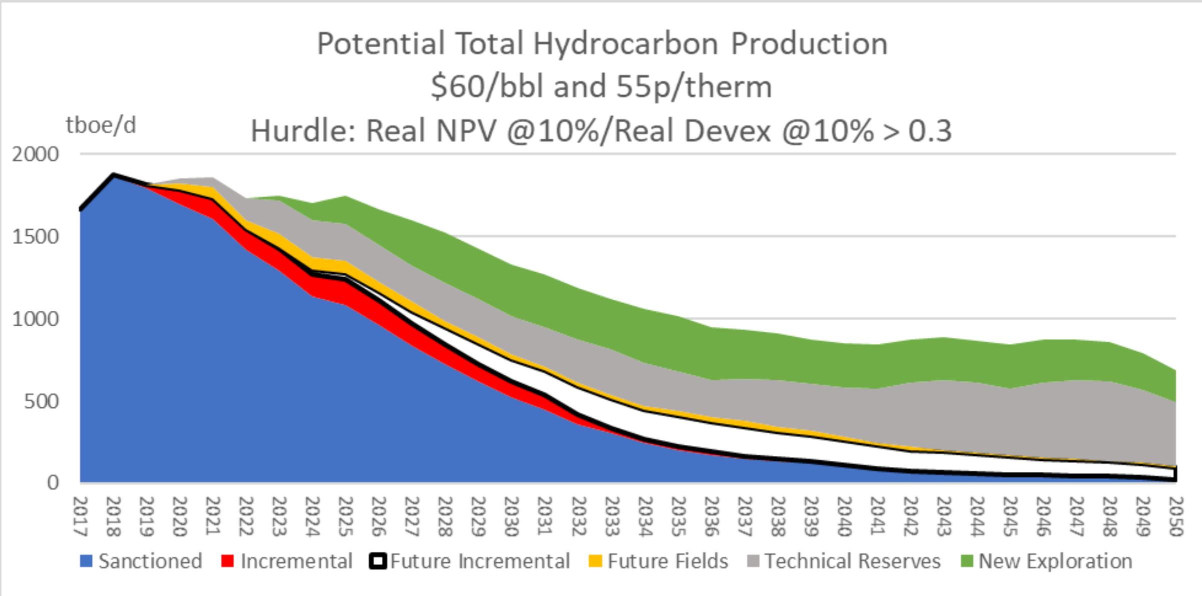
Chart 12



It is seen that 2,359 mmboe come from the SNS area, 1,972 mmboe from the CNS/MF area, 994 mmboe from the NNS, 510 mmboe from the WoS area, and 305 mmboe from the Irish Sea.

In Chart 13 potential total hydrocarbon production over the period 2018 to 2050 is shown for the $60, 55 pence case.

Chart 13



Over the period total hydrocarbon production is just over 14,780 million barrels of oil equivalent of which 6,685 mmboe come from sanctioned fields, 631 mmboe from current incremental projects, 1,211 mmboe from future incremental projects, 358 mmboe from probable and possible fields, 3,238 mmboe from technical reserves, and 2,657 mmboe from future discoveries.

In Chart 13a prospective total hydrocarbon production is shown in the historic context of production to date.

Chart 13a

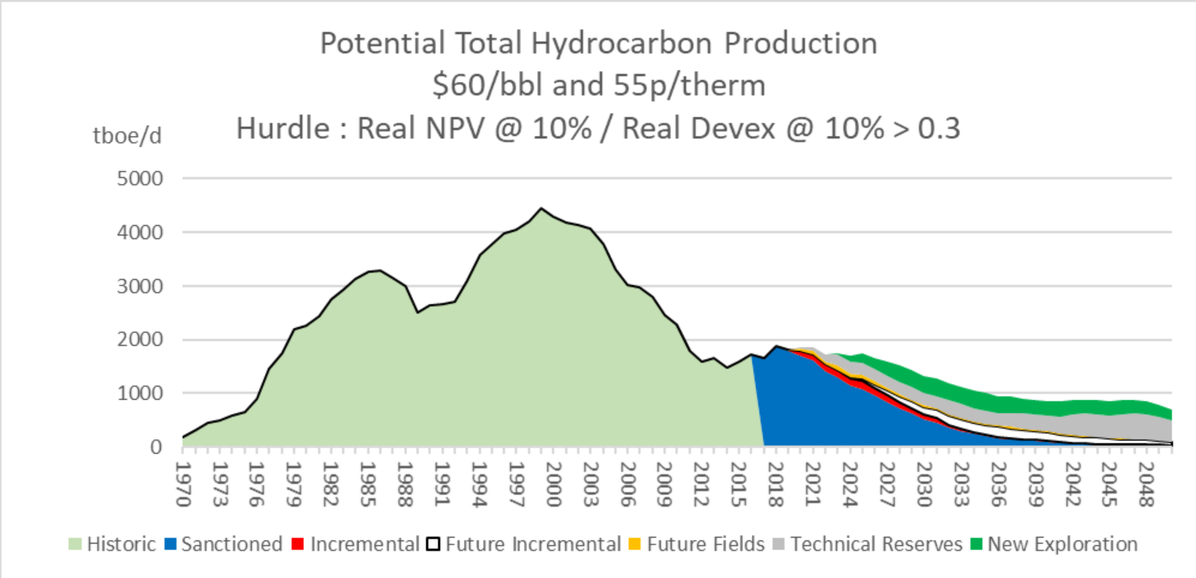
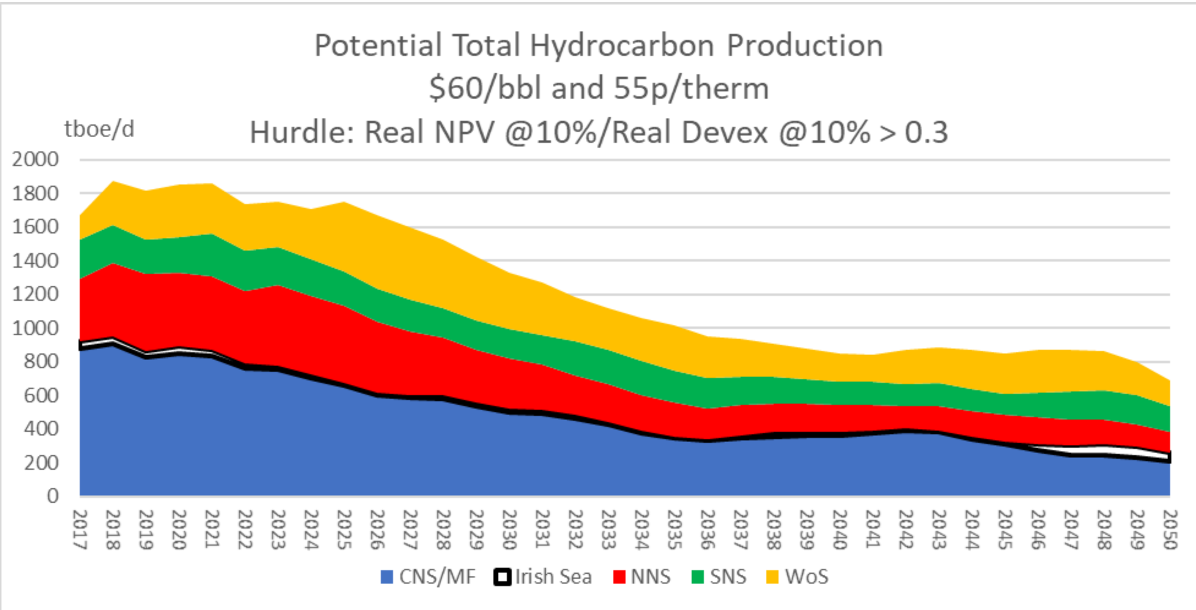


Chart 14 shows future production on a geographic basis.

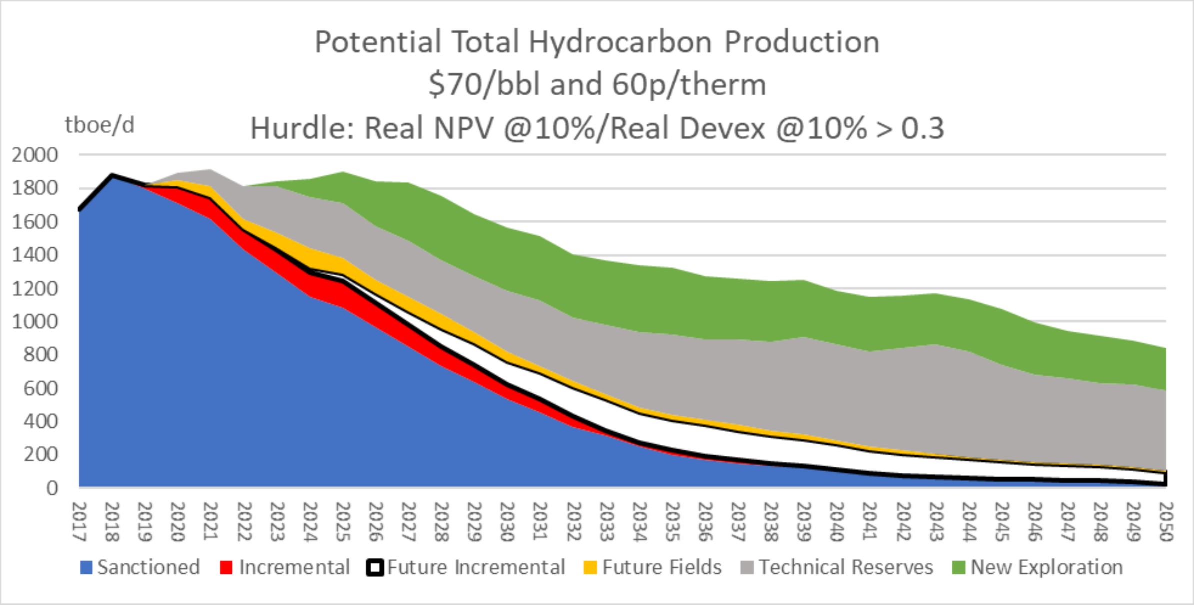
Chart 14



It is seen that 5,838 mmboe come from the CNS/MF area, 3,247 mmboe from the WoS area, 3,202 mmboe from the NNS, 2,173 mmboe from the SNS area, and 320 mmboe from the Irish Sea.

In Chart 15 potential total hydrocarbon production over the period 2018 to 2050 is shown for the $70, 60 pence case.

Chart 15



Over the period total hydrocarbon production is just over 17,151 million barrels of oil equivalent of which 6,736 mmboe come from sanctioned fields, 642 mmboe from current incremental projects, 1,238 mmboe from future incremental projects, 461 mmboe from probable and possible fields, 4,847 mmboe from technical reserves, and 3,228 mmboe from future discoveries.

In Chart 15a prospective total hydrocarbon production is shown in the historic context of production to date.

Chart 15a

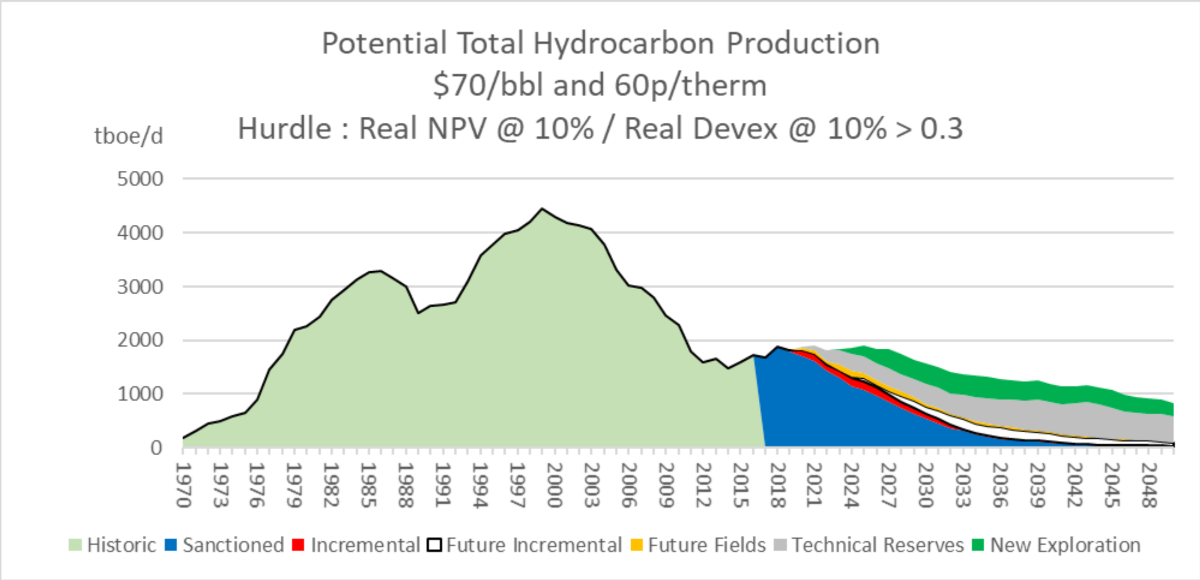
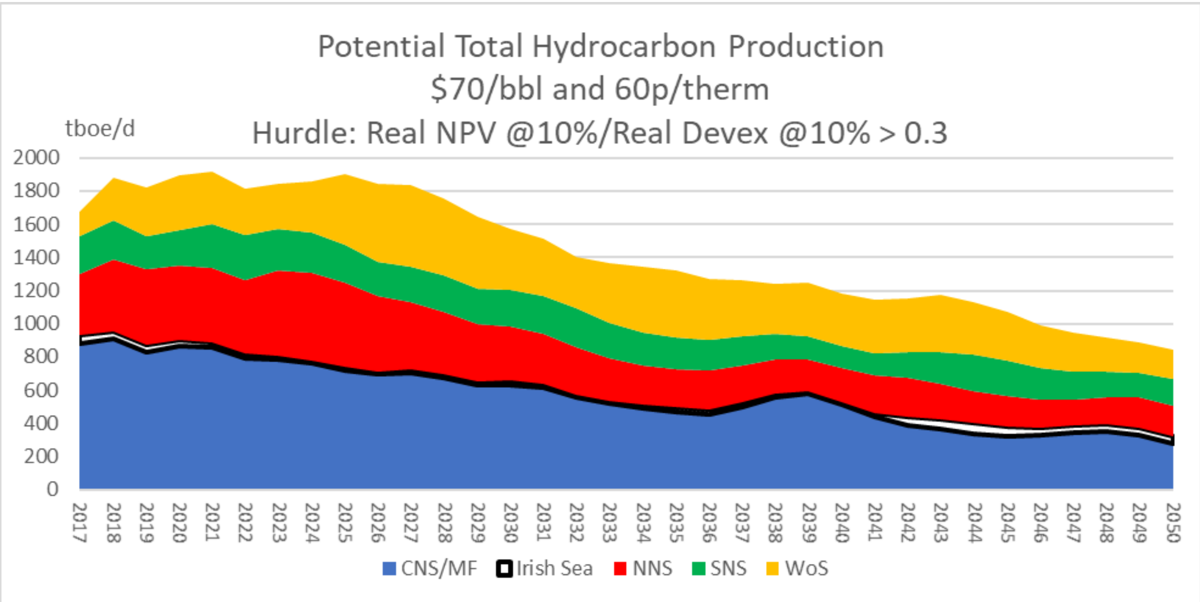


Chart 16 shows future production on a geographic basis.

Chart 16

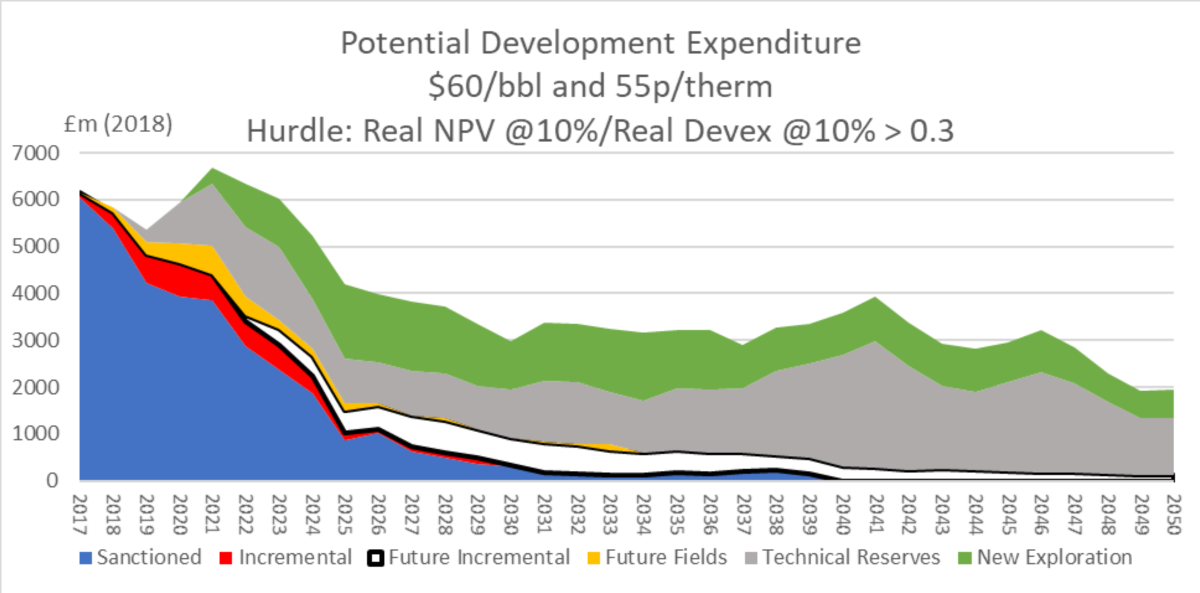


It is seen that 6,784 mmboe comes from the CNS/MF area, 3,949 mmboe from the WoS area, 3,631 mmboe from the NNS, 2,401 mmboe from the SNS area, and 386 mmboe from the Irish Sea.

c) Potential Development Expenditure

Potential development expenditure is shown in Chart 17 for the $60, 55 pence case.

Chart 17



Over the period 2018 to 2050 total development expenditure is just under £124,380 million at 2018 prices. The sanctioned fields contribute £29,547 million by 2040. Current incremental projects contribute £4,301 million by 2032 and future incremental projects contribute £10,918 million. The probable and possible fields contribute £2,608 million, the technical reserves contribute £45,652 million, and the future discoveries contribute £31,353 million.

In Chart 17a prospective development expenditure is shown in the context of historic expenditure to date (at 2018 prices).

Chart 17a

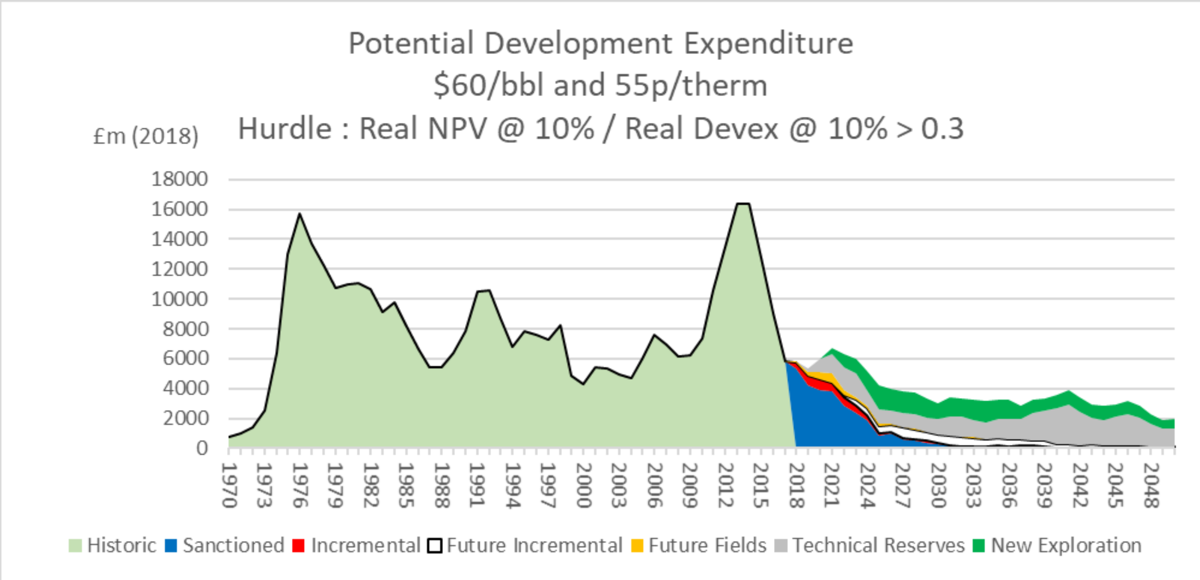
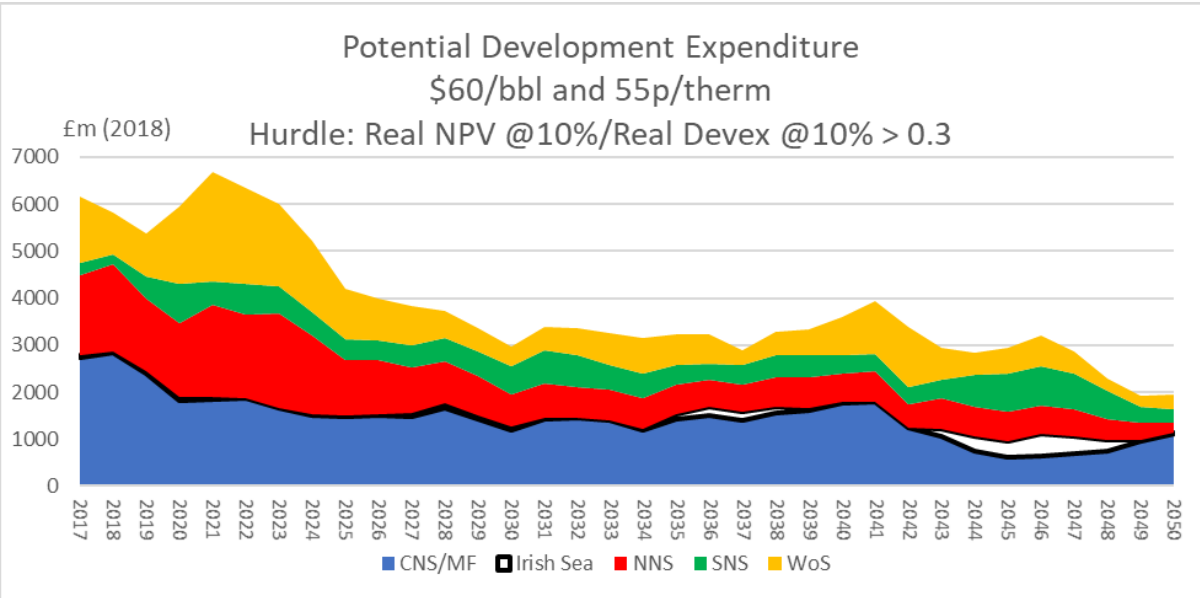


Chart 18 shows future expenditure on a geographic basis.

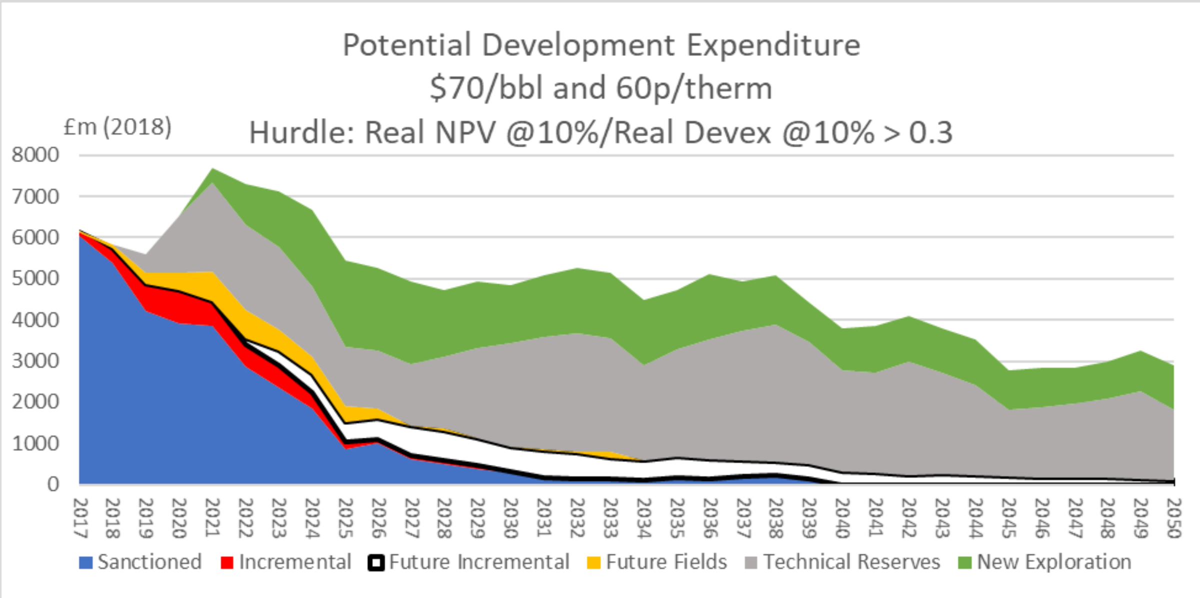
Chart 18



Prospective development expenditure in the CNS/MF area is £46,793 million, in the NNS £29,741 million, in the WoS area £27,271 million, in the SNS area £17,173 million, and in the Irish Sea £3,401 million.

Potential development expenditure is shown in Chart 19 for the $70, 60 pence case.

Chart 19



Over the period 2018 to 2050 total development expenditure is just under £157,836 million at 2018 prices. The sanctioned fields contribute £29,552 million by 2040. Current incremental projects contribute £4,448 million by 2032, and future incremental projects contribute £11,318 million. The probable and possible fields contribute £4,020 million, the technical reserves £69,244 million, and future discoveries contribute £39,253 million.

In Chart 19a prospective development expenditure is shown in the context of historic expenditure to date (2018 prices).

Chart19a

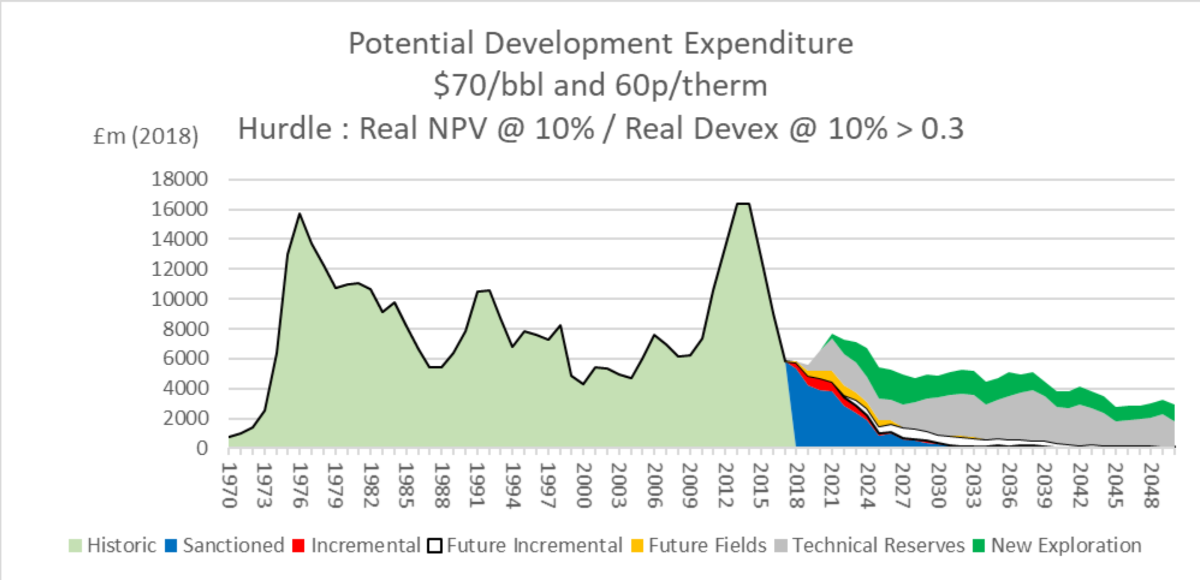
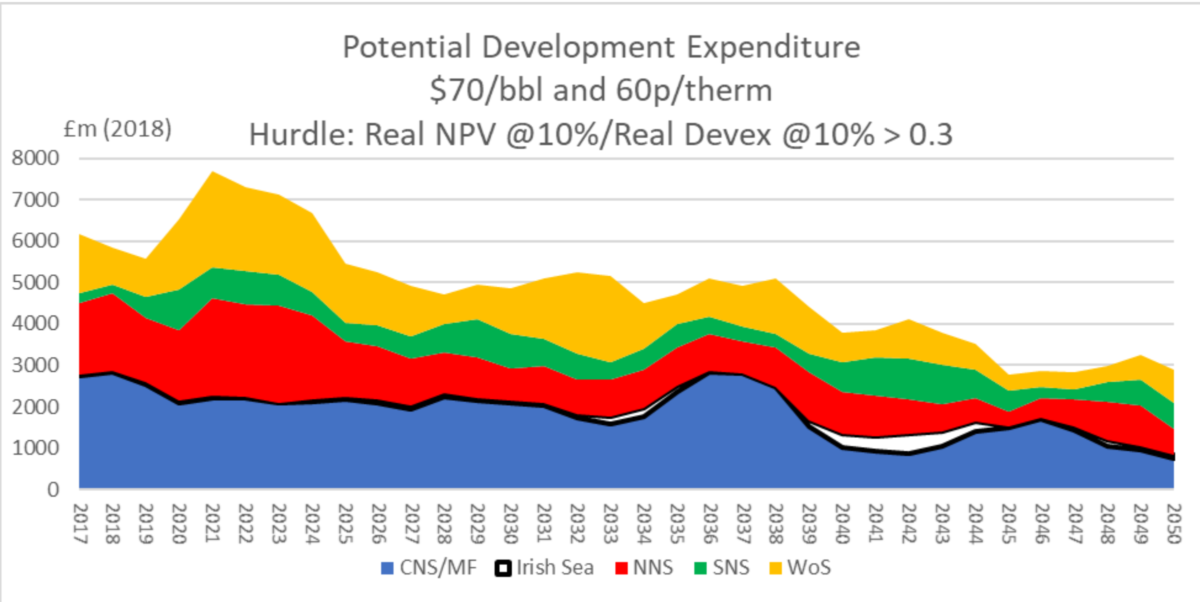


Chart 20 shows future expenditure a geographic basis.

Chart 20

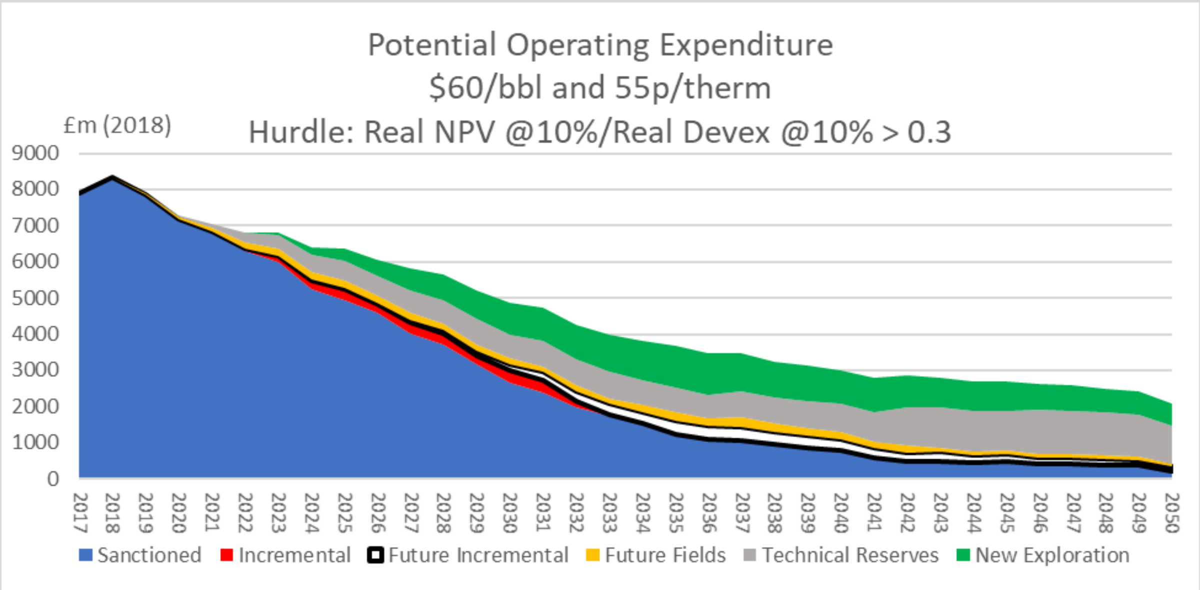


Prospective development expenditure in the CNS/MF area is £60,548 million, in the NNS £36,969 million, in the WoS area £36,721 million, in the SNS area £19,786 million, and in the Irish Sea £3,811 million.

d) Potential Operating Expenditure

Potential operating expenditure is shown in Chart 21 for the $60, 55 pence case.

Chart 21



Over the period 2018 to 2050 total operating expenditure is just over £147,284 million at 2018 prices. The sanctioned fields contribute £88,438 million. Current incremental projects contribute £3,103 million and future incremental projects contribute £5,814 million. The probable and possible fields contribute £4,943 million, the technical reserves £23,134 million, and future discoveries contribute £21,852 million.

In Chart 21a prospective operating expenditure is shown in the context of historic expenditure to date (2018 prices).

Chart 21a

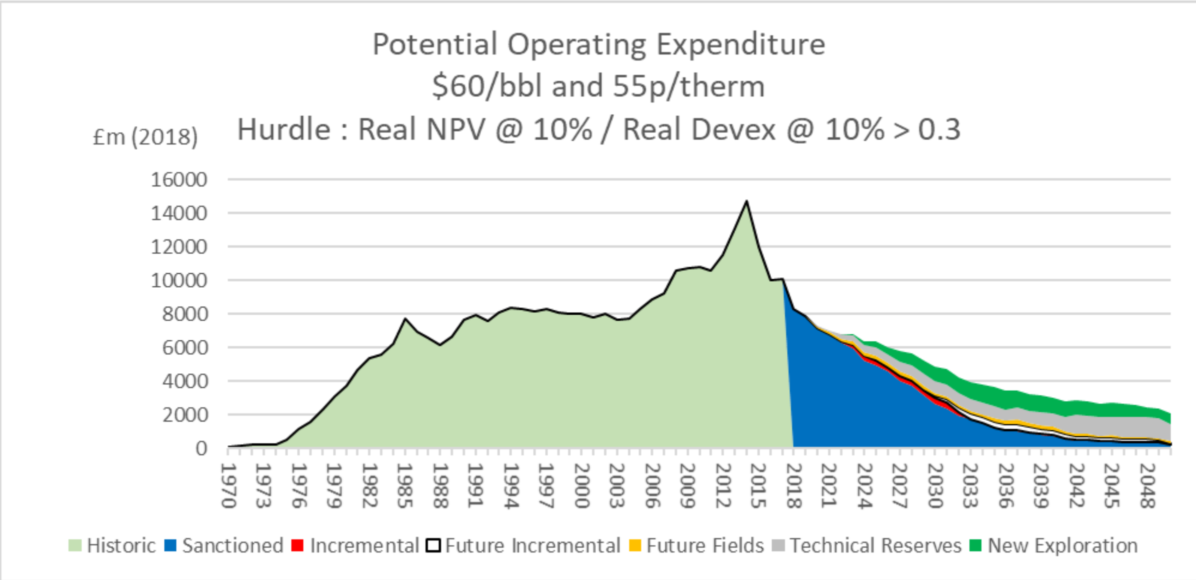
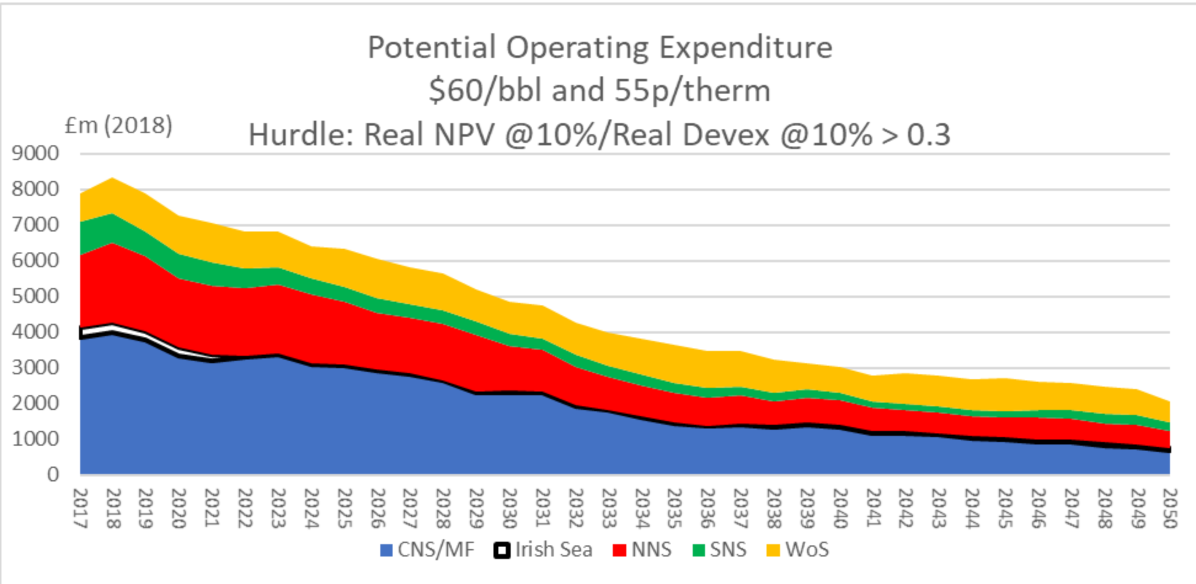


Chart 22 shows future expenditure on a geographic basis.

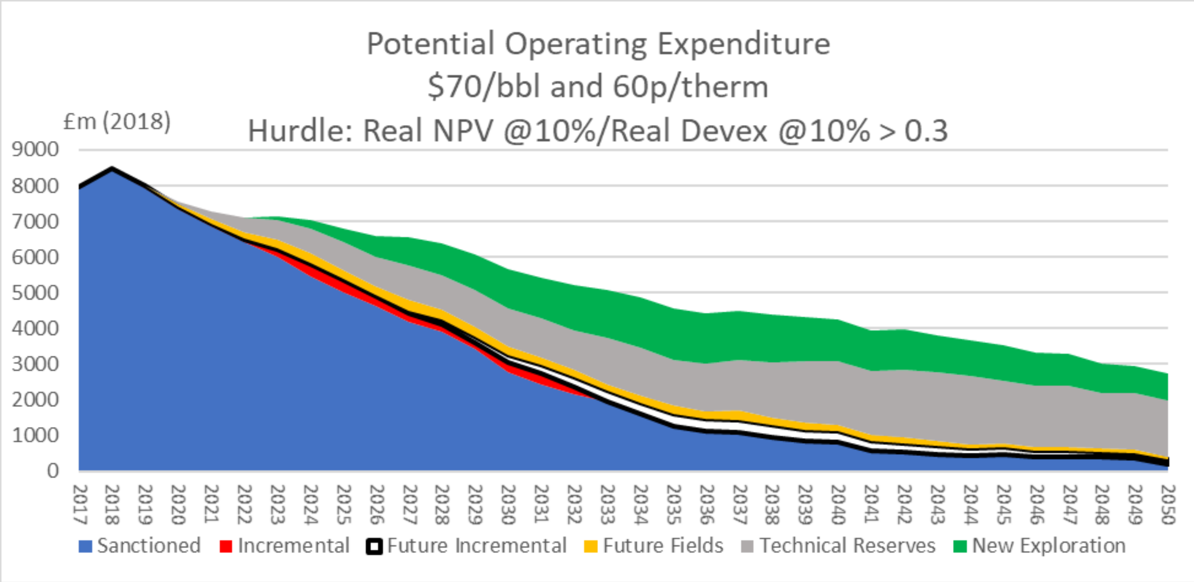
Chart 22



Potential operating expenditure in the CNS/MF area is £65,638 million, in the NNS £37,470 million, in the WoS area £30,340 million, in the SNS area £11,489 million, and in the Irish Sea £2,347 million.

Potential operating expenditure is shown in Chart 23 for the $70, 60 pence case.

Chart 23



Over the period 2018 to 2050 total operating expenditure is just under £171,833 million at 2018 prices. The sanctioned fields contribute £90,820 million. Current incremental projects contribute £3,014 million and future incremental projects contribute £5,733 million. The probable and possible fields contribute £5,727 million, the technical reserves contribute £38,823 million, and the future discoveries contribute £27,716 million.

In Chart 23a prospective operating expenditure is shown in the context of historic expenditure to date (2018 prices).

Chart 23a

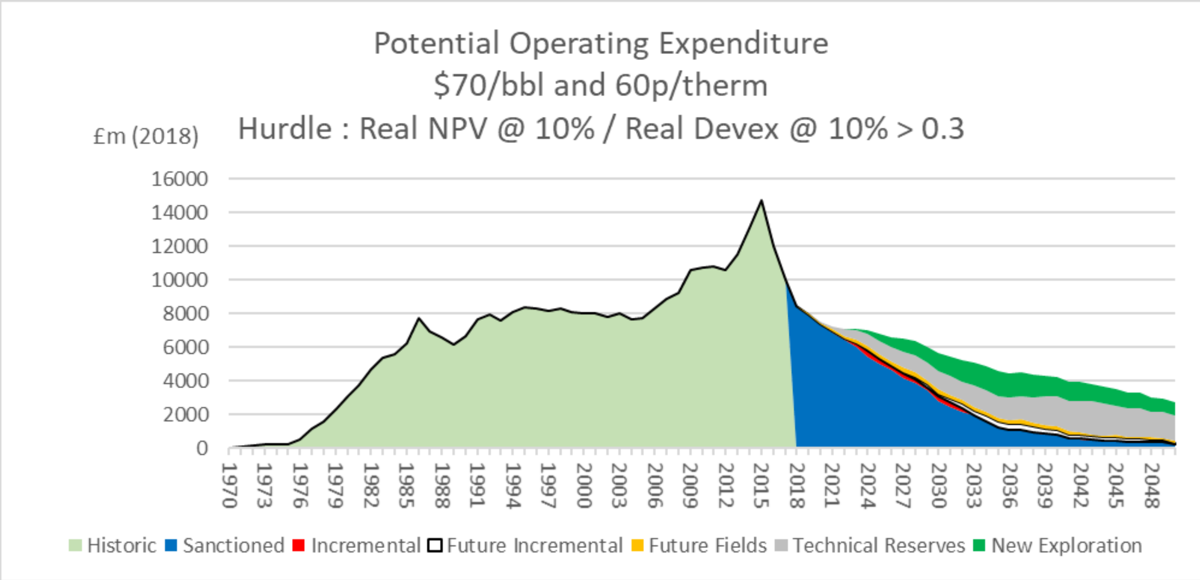
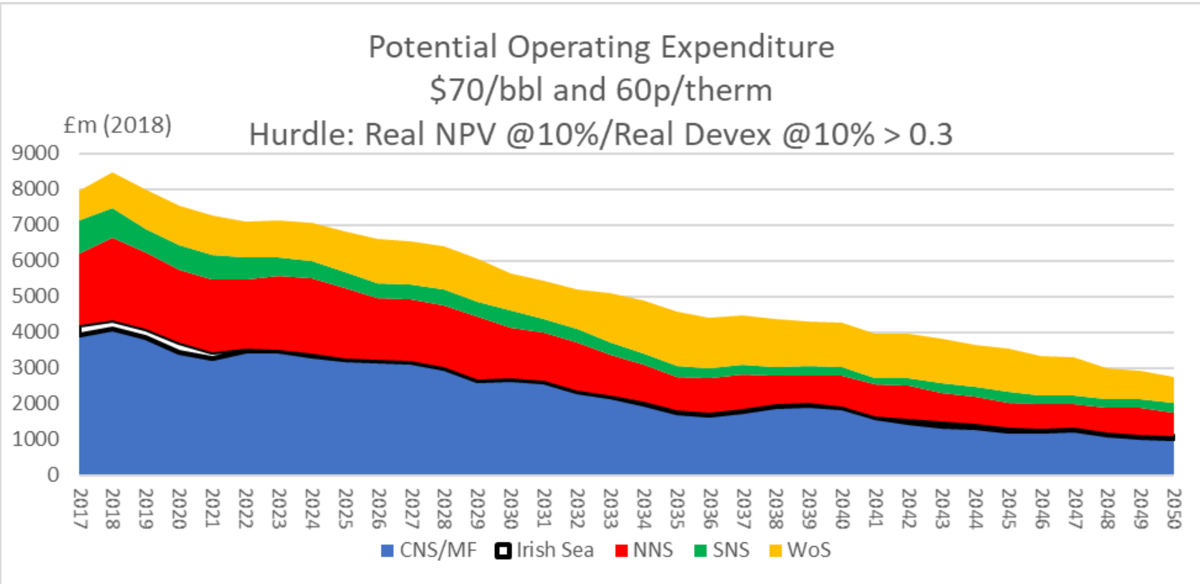


Chart 24 shows future expenditure on a geographic basis.

Chart 24

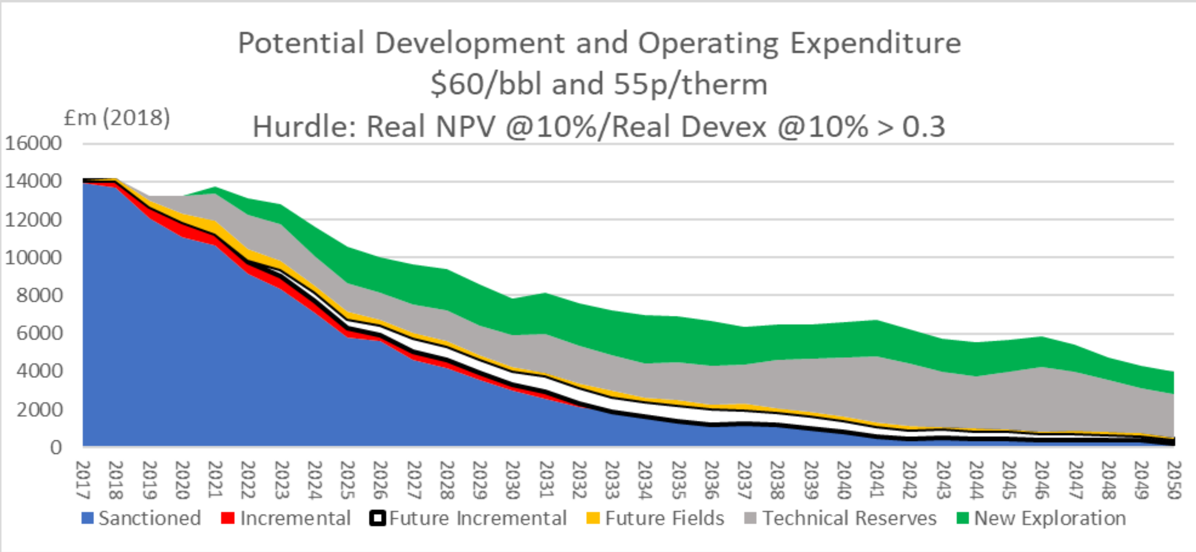


Operating expenditure in the CNS/MF area is £75,697 million, in the NNS £42,464 million, in the WoS area £38,242 million, in the SNS area £12,731 million, and in the Irish Sea £2,699 million.

e) Potential Development plus Operating expenditures

Potential development and operating expenditures are shown in Chart 25.

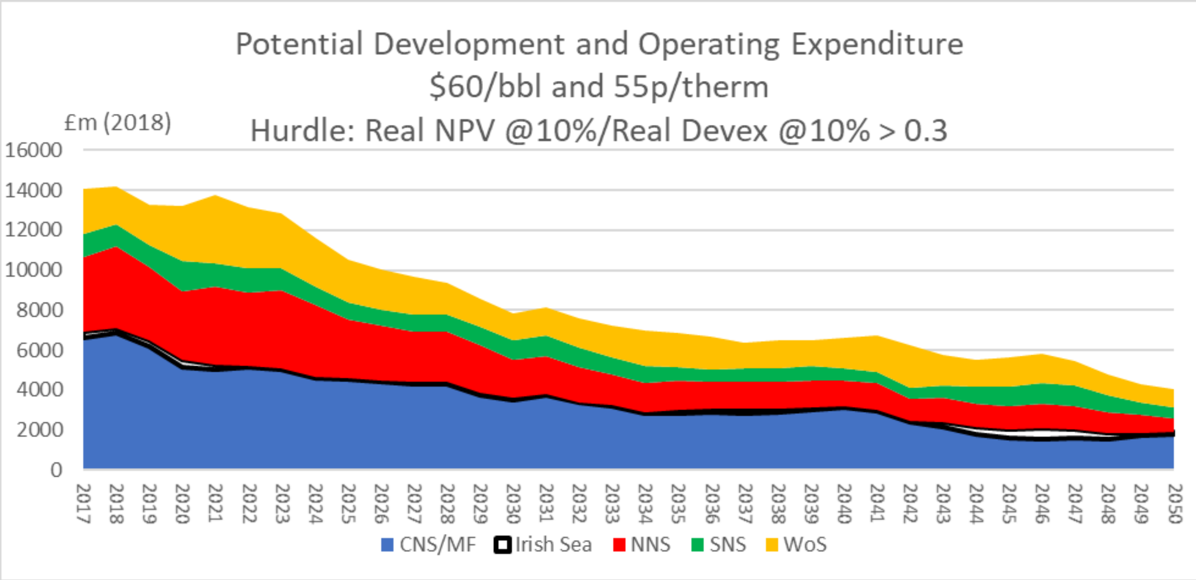
Chart 25



Over the period 2018 to 2050 expenditure is £271,664 million at 2018 prices. The sanctioned fields contribute £117,985 million. Current incremental projects contribute £7,405 million and future incremental projects contribute £16,733 million. The probable and possible fields contribute £7,551 million, the technical reserves £68,786 million, and future discoveries £53,205 million.

Chart 26 gives the same information on a geographic basis.

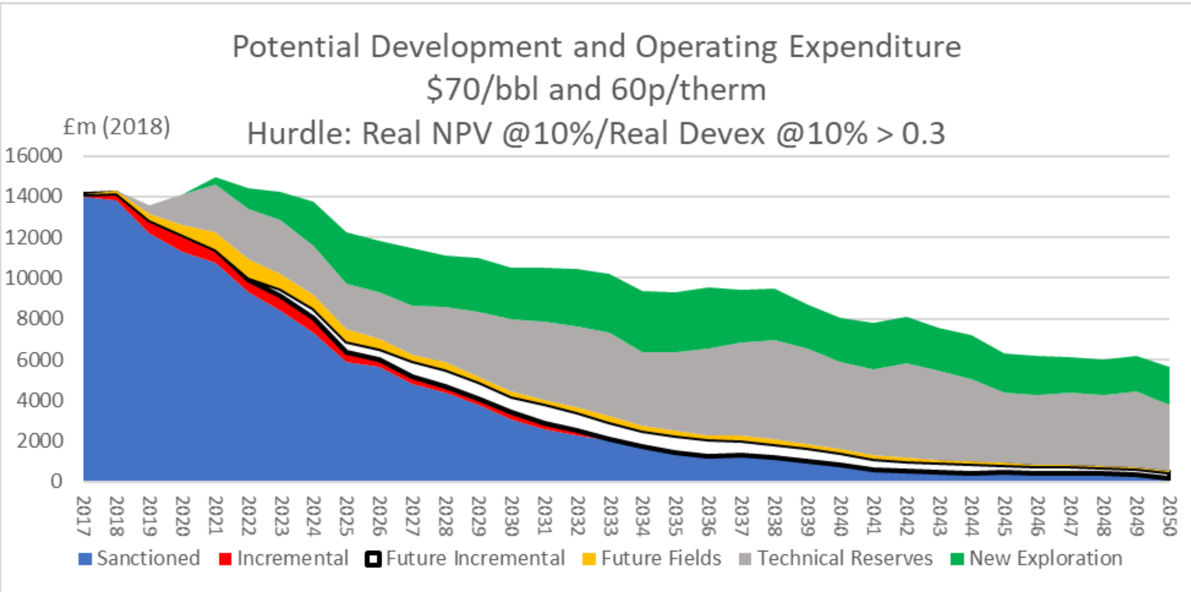
Chart 26



Potential development and operating expenditures in the CNS/MF area are £112,431 million, in the NNS £67,211 million, in the WoS area £57,611 million, in the SNS area £28,662 million, and in the Irish Sea £5,749 million.

Potential development and operating expenditures are shown in Chart 27 for the $70, 60 pence case.

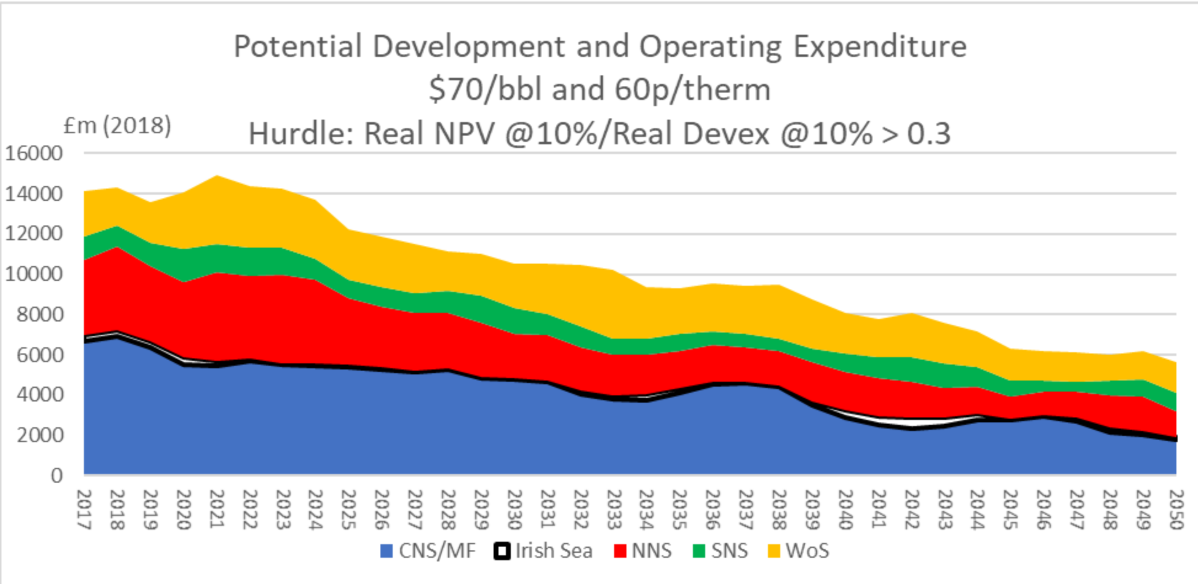
Chart 27



Over the period 2018 to 2050 the total is just under £329,669 million at 2018 prices. The sanctioned fields contribute £120,372 million. Current incremental projects contribute £7,462 million, and future incremental projects contribute £17,052 million. The probable and possible fields contribute £9,746 million, technical reserves contribute £108,067 million, and future discoveries contribute £66,969 million.

Chart 28 gives the same information on a geographic basis.

Chart 28

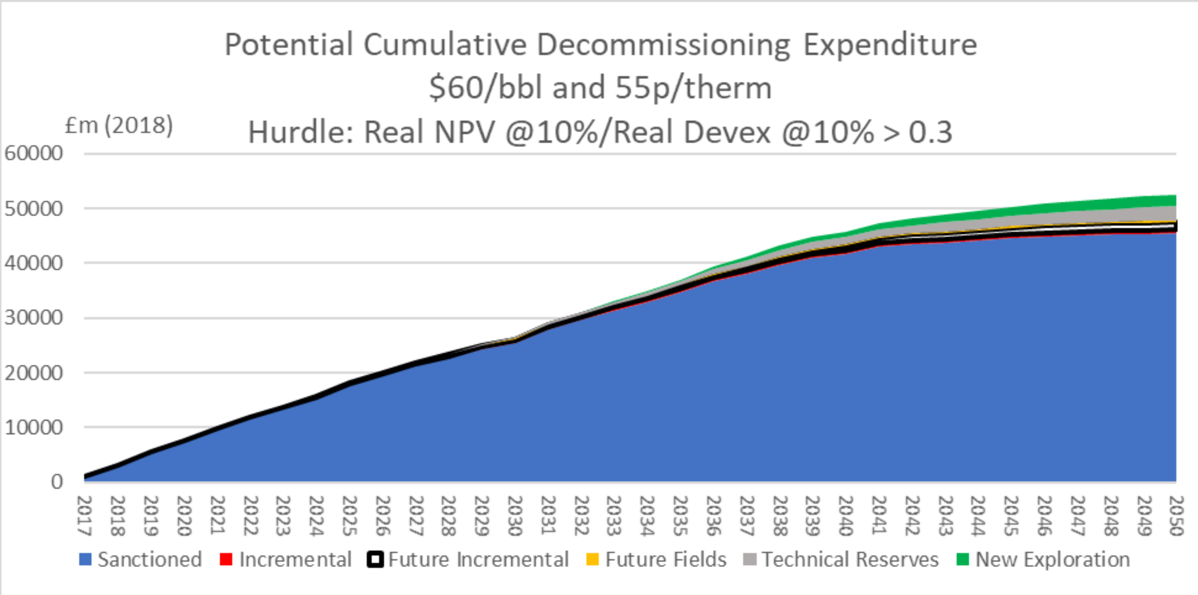


Potential expenditure in the CNS/MF area is £136,245 million, in the NNS £79,433 million, in the WoS area £74,963 million, in the SNS area £32,518 million, and in the Irish Sea £6,510 million.

f) Potential Decommissioning Activity

Chart 29 shows the potential cumulative decommissioning costs 2018 – 2050 for the $60, 55 pence case at 2018 prices.

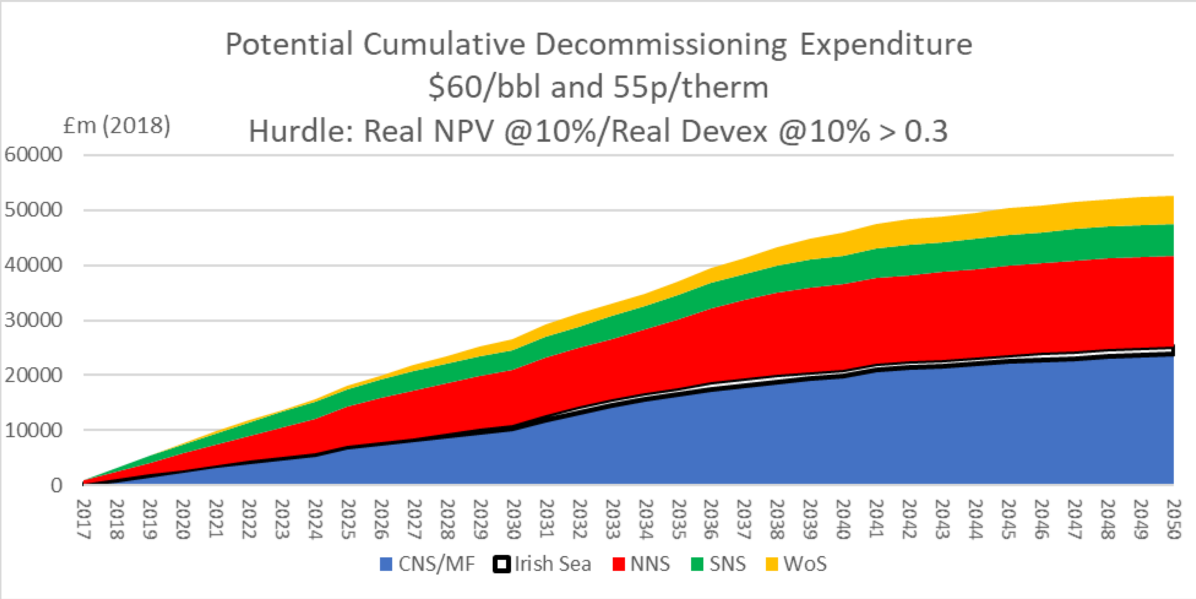
Chart 29



Cumulative decommissioning costs could be £52,616 million by 2050, with 86% coming from sanctioned fields. The sanctioned fields account for £45,407 million, the current incremental projects £706 million, future incremental projects £1,382 million, probable and possible fields £278 million, technical reserve fields £2,647 million, and future new exploration finds £2,196 million. 50% of the decommissioning spend will have been incurred by 2030 and 70% by 2035.

Chart 30 gives the same information on a geographic basis.

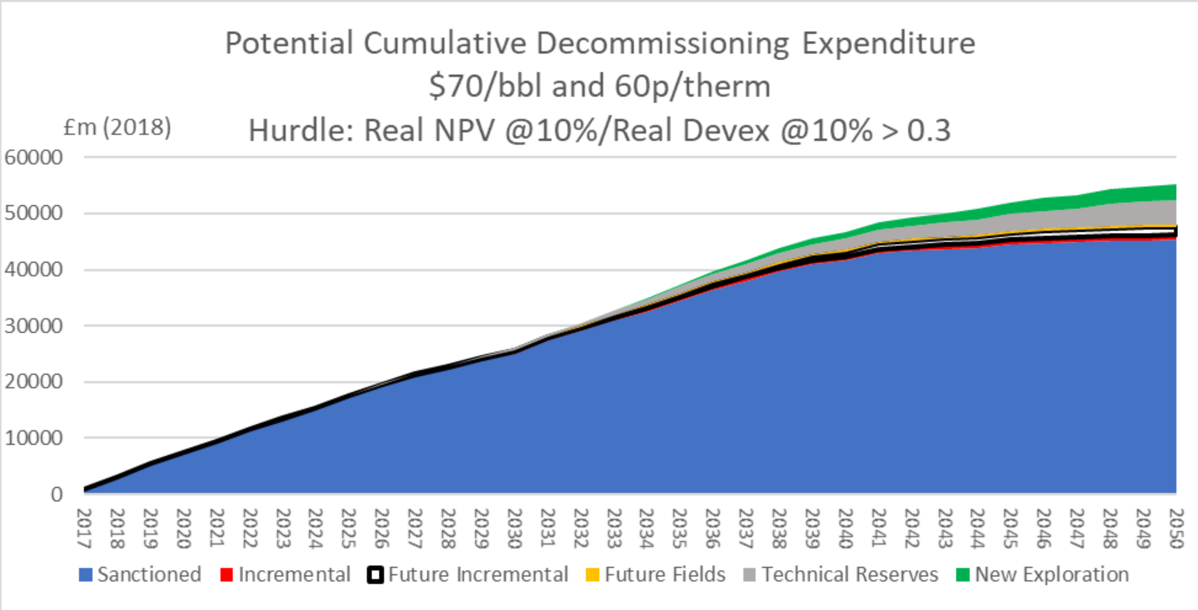
Chart 30



Potential decommissioning expenditure in the CNS/MF area is £23,936 million which is over 45% of the total spend. In the NNS it becomes £16,510 million which is over 31% of the total spend. In the WoS area it is £5,044 million, in the SNS area £5,868 million, and in the Irish Sea £1,259 million.

Chart 31 shows the cumulative decommissioning costs for the $70, 60 pence case.

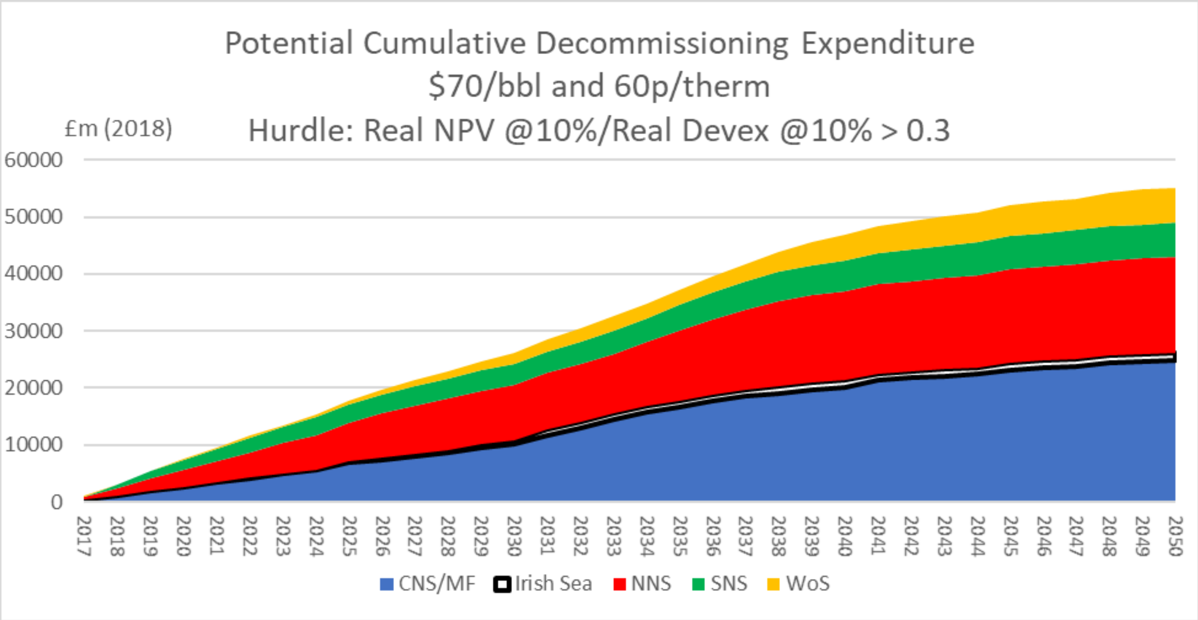
Chart 31



Potential cumulative decommissioning costs could be just over £55,159 million by 2050, with 82% coming from sanctioned fields. The sanctioned fields account for £45,339 million, the current incremental projects £833 million, future incremental projects £1,486 million, probable and possible fields £457 million, technical reserve fields £4,300 million, and future finds £2,745 million. 52% of the decommissioning spend will have been incurred by 2031 and 72% will have been incurred by 2036.

Chart 32 gives the same information on a geographic basis.

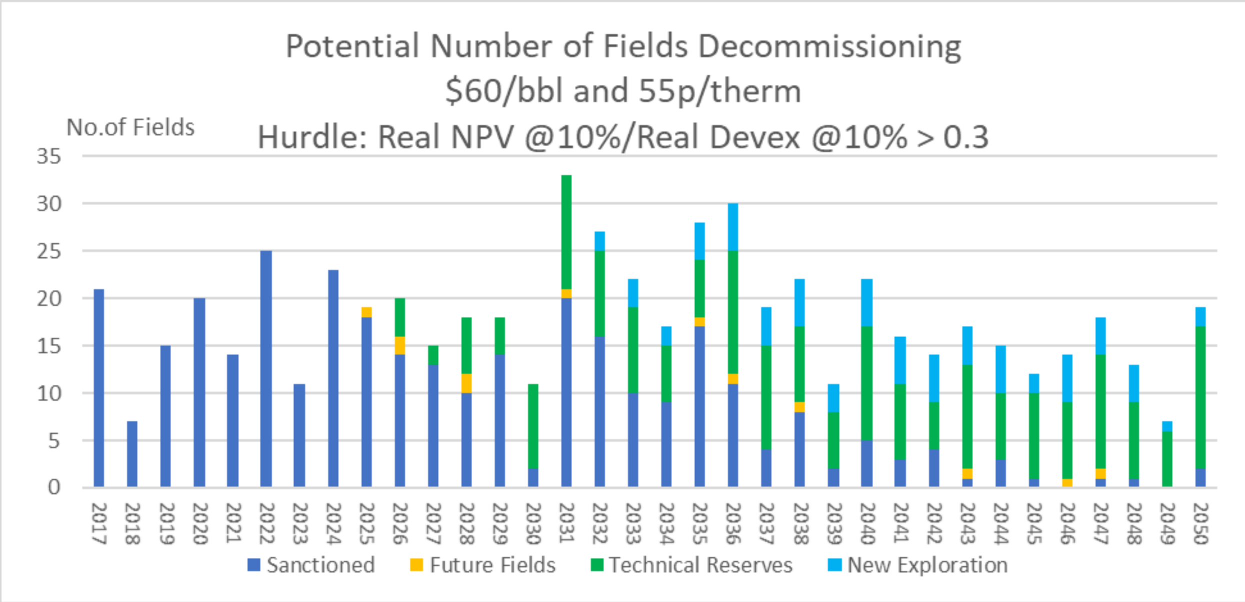
Chart 32



Potential decommissioning expenditure in the CNS/MF area is £24,938 million which is over 45% of the total spend. In the NNS £16,855 million which is almost 31% of the spend. In the WoS area it is £6,074 million, in the SNS area £6,010 million, and in the Irish Sea £1,284 million.

Decommissioning expenditure is spread over many years for most fields. Chart 33 shows the number of fields decommissioning starting to decommission in the $60, 55 pence case.

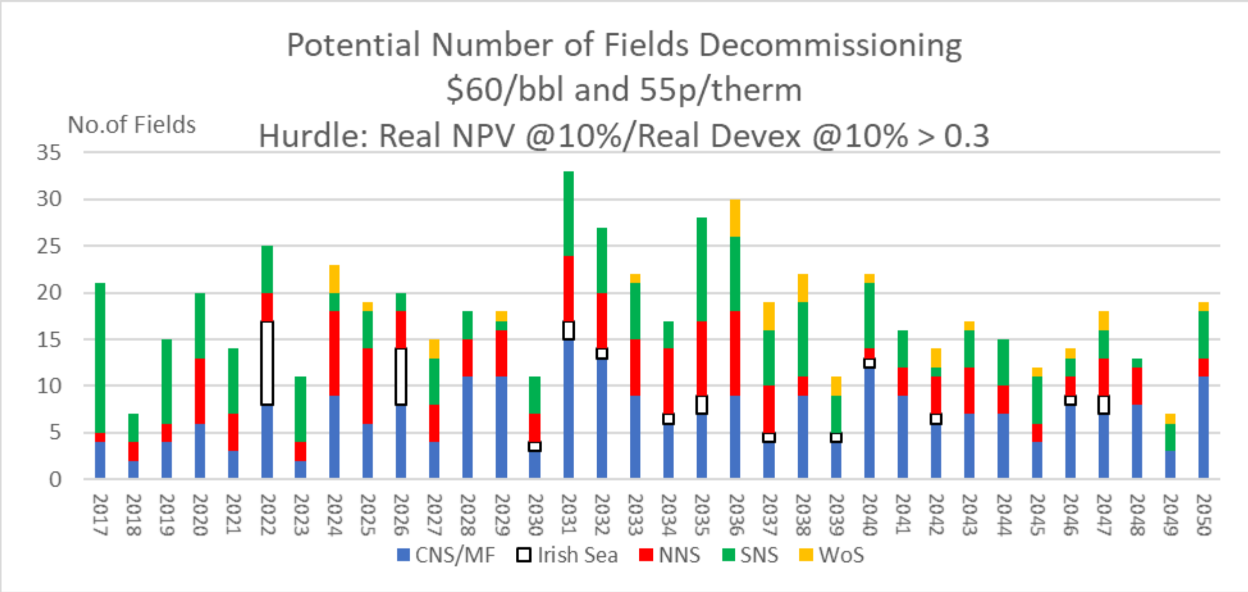
Chart 33



By 2030 there will be 216 fields having completed or be engaged in decommissioning. By 2035 the total could be 343 fields, and by 2050 there could be 592 fields having completed or be engaged in decommissioning. By 2030 186 sanctioned fields, 5 probable or possible fields and 25 technical reserve fields will have completed or be engaged in decommissioning. By 2050 there will be 304 sanctioned fields, 12 probable or possible fields, 206 technical reserve fields, and 70 future finds having completed or be engaged in decommissioning.

Chart 34 gives the same information on a geographic basis.

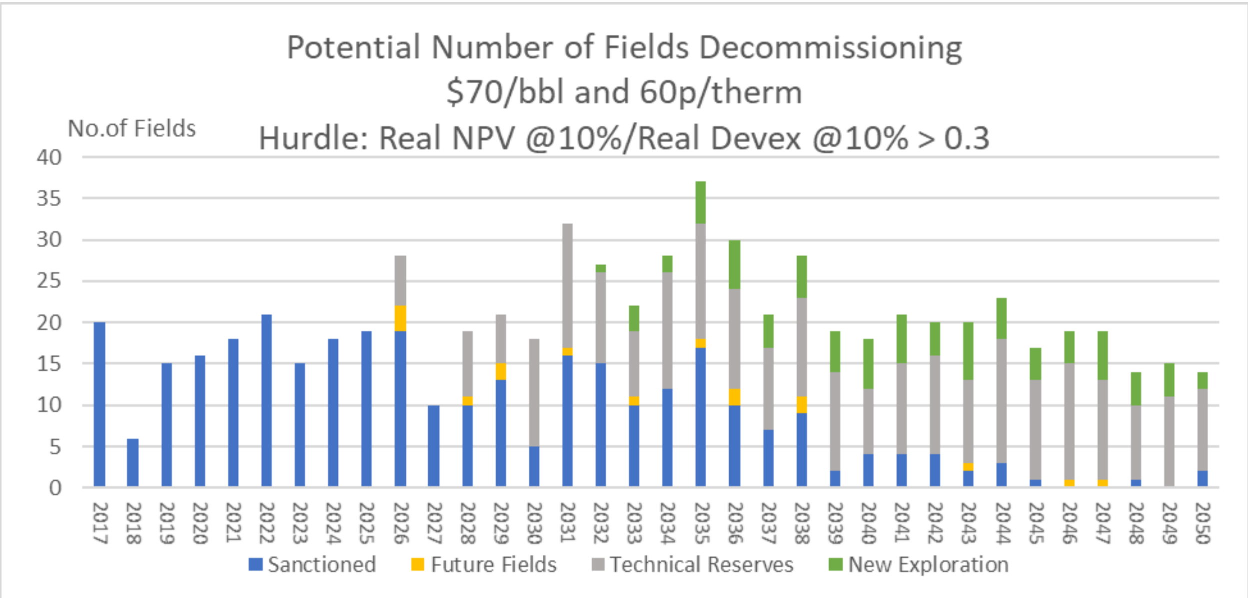
Chart 34



By 2030 77 CNS/MF fields, 59 SNS fields, 57 NNS fields, 16 Irish Sea fields, and 7 WoS fields will have completed or be engaged in decommissioning. By 2050 235 CNS/MF fields, 161 SNS fields, 137 NNS fields, 29 Irish Sea fields and 30 WoS fields will have completed or be engaged in decommissioning.

Chart 35 shows the number of fields decommissioning for the $70, 60 pence case.

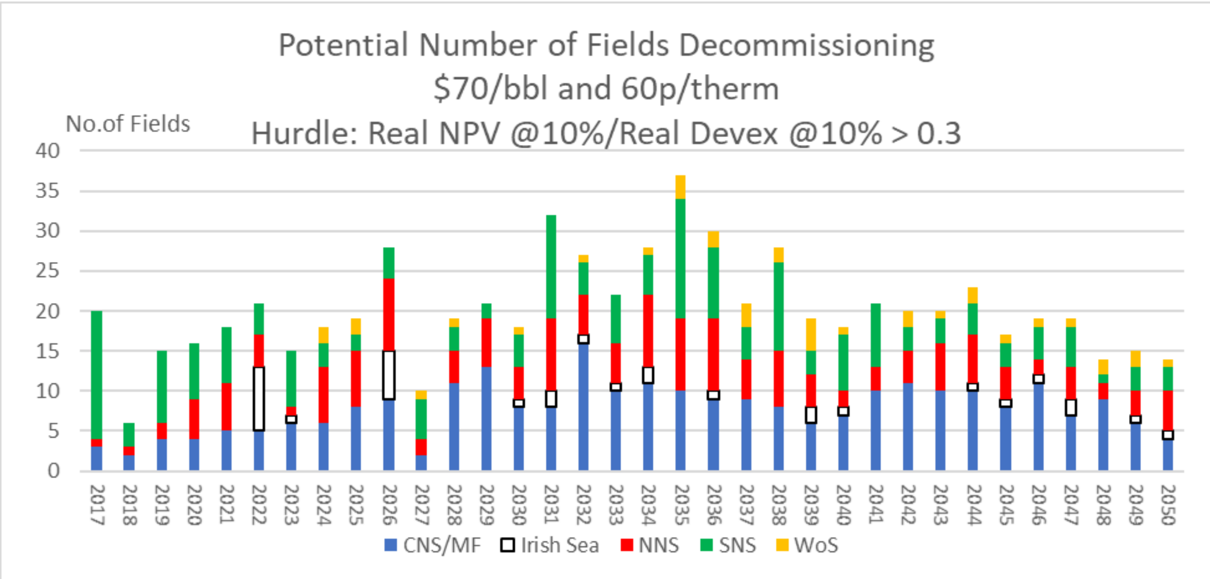
Chart 35



By 2030 224 fields will have completed or be engaged in decommissioning. By 2035 370 fields will have completed or be engaged in decommissioning, and by 2050 668 fields will have completed or be engaged in decommissioning. By 2030 185 sanctioned fields, 6 probable or possible fields, and 33 technical reserve fields will have completed or be engaged in decommissioning. By 2050 304 sanctioned fields, 16 probable or possible fields, 265 technical reserve fields, and 83 future finds will have completed or be engaged in decommissioning.

Chart 36 gives the same information on a geographic basis.

Chart 36

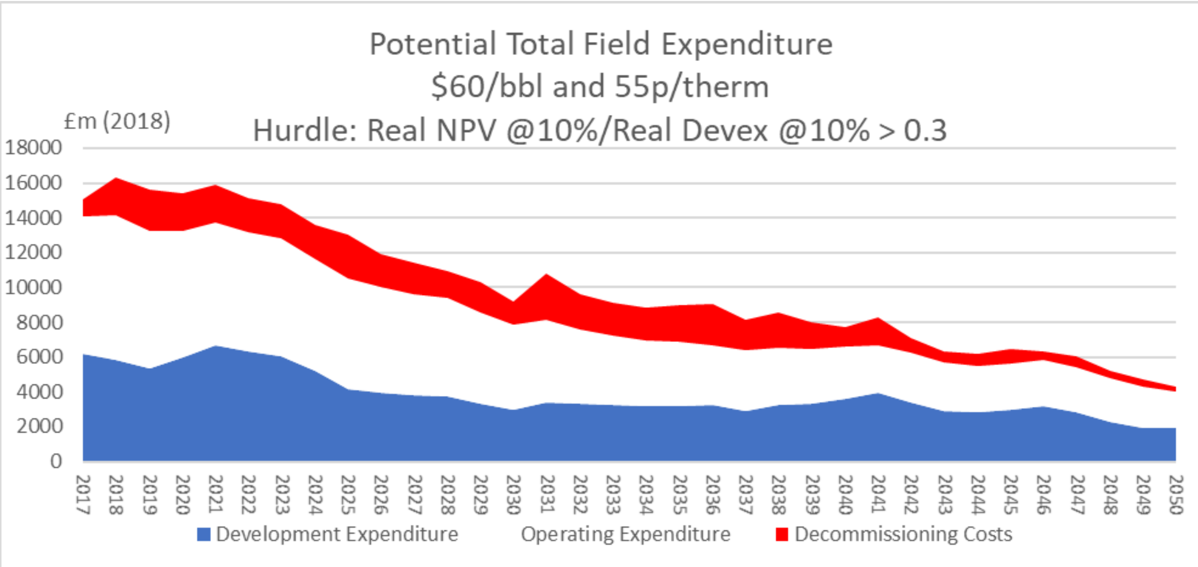


By 2030 83 CNS/MF fields, 60 SNS fields, 58 NNS fields, 16 Irish Sea fields, and 7 WoS fields will have completed or be engaged in decommissioning. By 2050 263 CNS/MF fields, 174 SNS fields, 161 NNS fields, 33 Irish Sea fields, and 37 WoS fields will have completed or be engaged in decommissioning.

g) Potential Total Field Expenditures

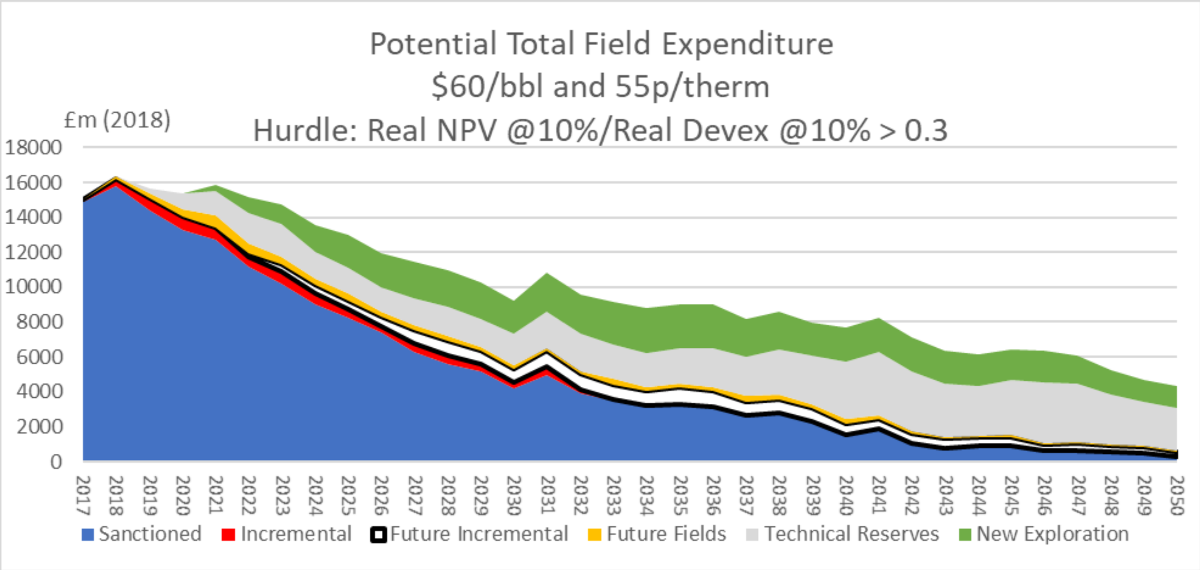
In Chart 37 prospective aggregate field-related expenditures (development, operations, and decommissioning) are shown under the $60, 55 pence case. It is seen that they fall continuously from current levels to 2050 at a rate which becomes brisk from around 2022. From an annual total of £16 billion the level declines to around £4 billion at today's prices in 2050.

Chart 37



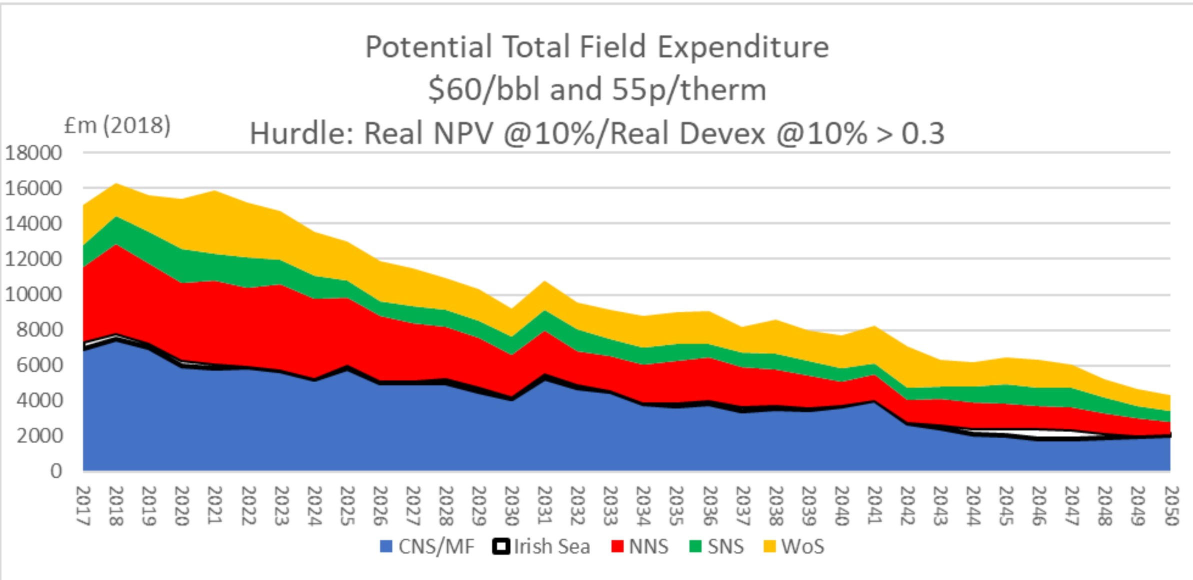
In Chart 38 the results for total field-related expenditures are shown by categories of fields and projects. The long-term importance of fields in the category of technical reserves is highlighted.

Chart 38



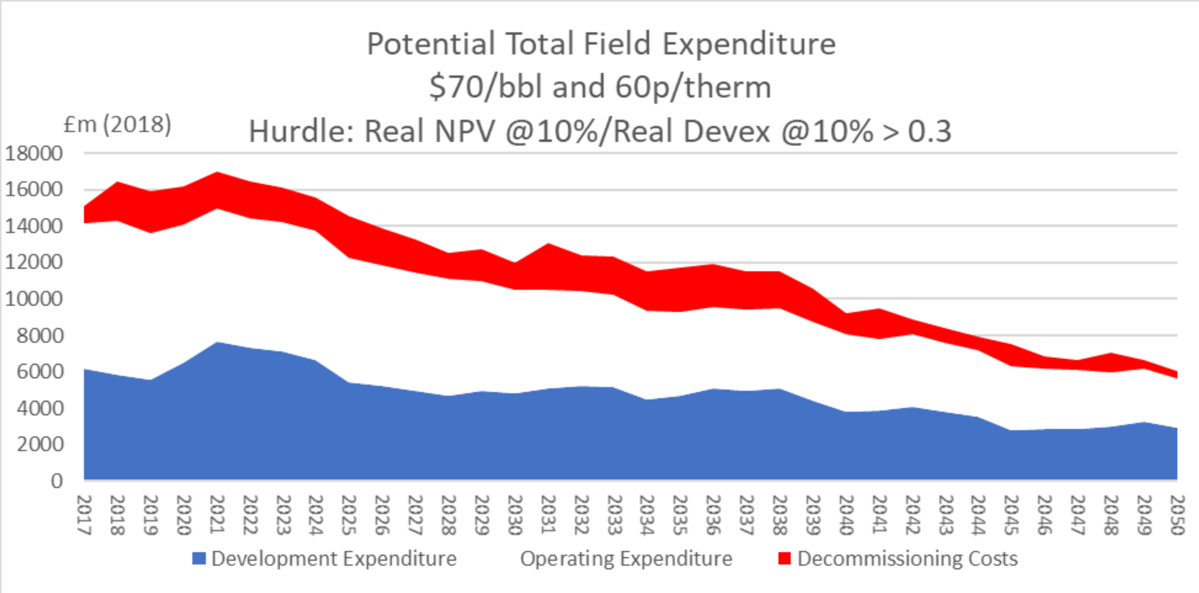
In Chart 39 the regional breakdown of prospective field-related expenditures is shown. The growing importance of the W of S region and the continued importance of the CNS/MF area are highlighted.

Chart 39



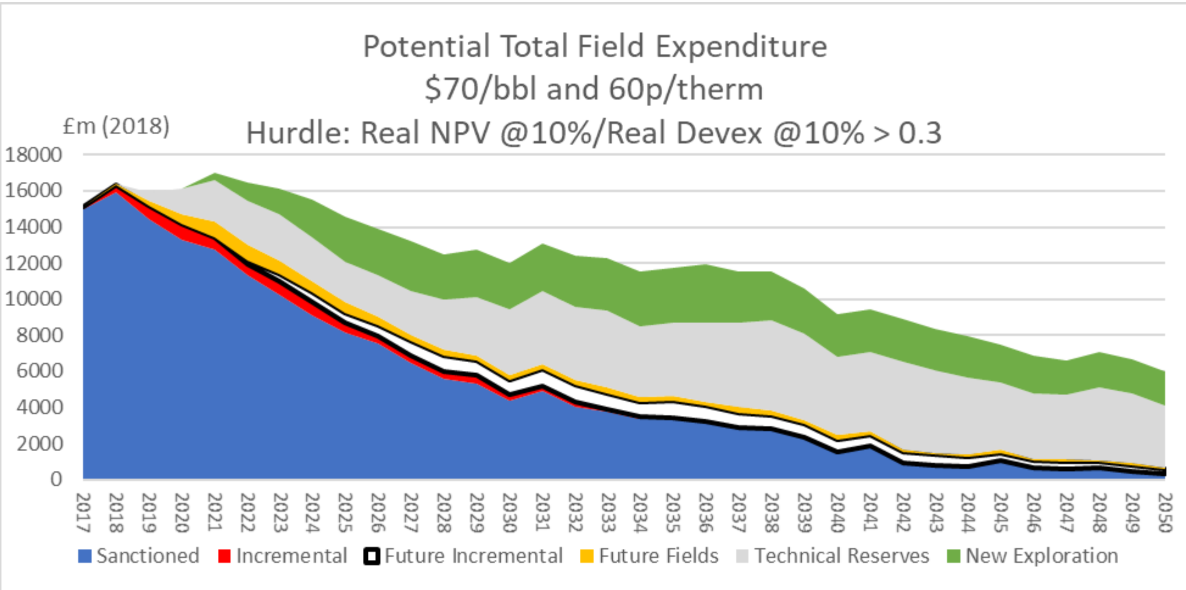
In Chart 40 prospective total field-related expenditures by the three main categories are shown with the $70, 60 pence price case. In the near term expenditures are above current levels. The long term decline rate is also much lower than with the $60, 55 pence case. In 2050 the total expenditure is around £6 billion at today's prices.

Chart 40



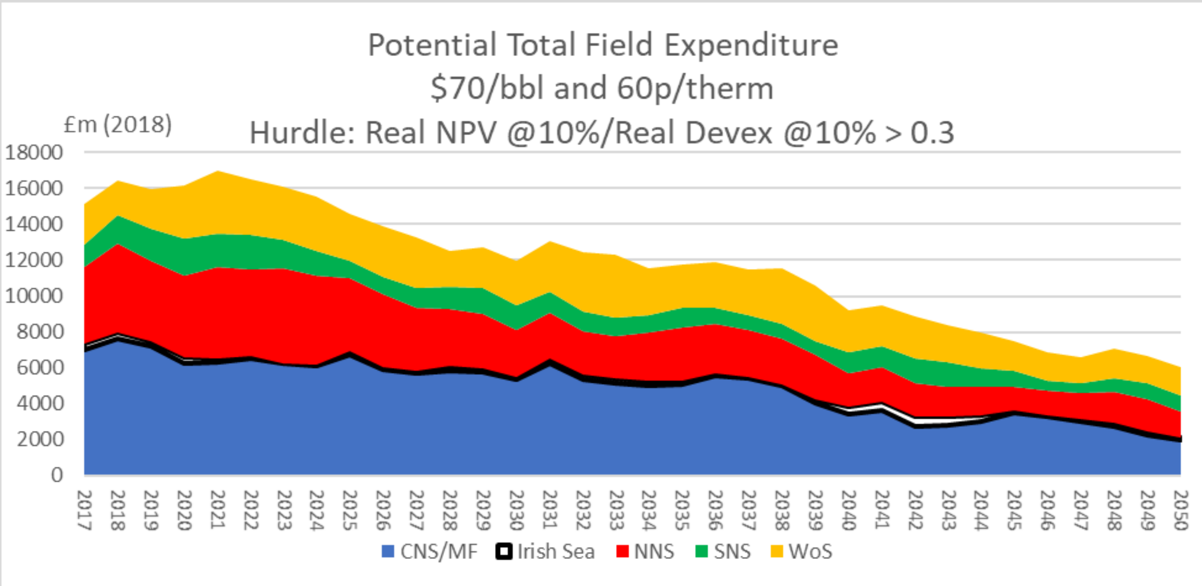
In Chart 41 the prospective total field-related expenditures under the $70, 60 pence case are shown by category of field and project. The increasing importance of fields in the category of technical reserves is highlighted.

Chart 41



In Chart 42 prospective total field expenditures are shown according to geographic areas of the UKCS. The importance of the CNS/MF region and the growing importance of the W of S region are highlighted.

Chart 42



4. Summary and Conclusions

This study provides a reassessment of the long-term prospects for activity in the UKCS. The reassessment takes into account (1) the major cost reductions painfully realised since 2014, and (2) the enhanced production efficiency achieved over the past few years. The increases in oil and gas prices over the last year are recognised in the modelling. A further element in the long-term reassessment is the increased coverage of the numbers of fields in the category of technical reserves in the large database used in the modelling. Technical reserves are discovered fields not presently being actively considered for development. Information on them is generally incomplete.

The modelling of the long-term prospects incorporates future exploration activity and the fruits of the effort. Reflecting the trends in recent years the postulated effort is quite modest, though the success rate is on average quite high, again reflecting the experience of the past few years.

The modelling undertaken relates to databases incorporating 400 sanctioned fields, 19 fields in the categories of probable and possible fields, 90 incremental projects, and 408 fields in the category of technical reserves. The fields in the last category have a development cost premium of $5 per boe in real terms over current new field developments reflecting their greater challenges in achieving economic or commercial viability. Operating costs are also modelled as being higher on these fields.

Two exploration scenarios were modelled, both reflecting the size of the effort in recent years and the long-term trend in the average size of discovery. The future effort was also assumed to reflect prospective oil and gas prices. The assumed efforts were quite modest. Over the long period to 2050 137 discoveries were made in the case with medium effort and higher oil/gas prices, and 112 discoveries in the case with low effort and lower oil/gas prices.

The financial modelling was undertaken under two price scenarios for investment screening purposes, namely (1) $60 per barrel for oil and 55 pence for gas, (2) $70 per barrel and 60 pence for gas, all in real terms. These prices increase annually by the general inflation rate as do the costs. The investment hurdle has been set at NPV@10% / I@10% > 0.3 in real terms. This reflects the continued existence of capital rationing. The present tax system is incorporated in the modelling.

<u>$60, 55 pence case</u>

With the $60, 55 pence scenario key findings are that cumulative hydrocarbon production from 2018 to 2050 would be 14.8 billion barrels of oil equivalent (bn boe). This means that the production projections of Vision 2035 made by the OGA would be realised. It should be stressed that there are significant downside risks relating to this finding. In particular the achievement of 14.8 bn boe depends substantially on the development of 421 new fields of which no less than 295 are in the category of technical reserves. The development of these fields is by no means certain even though they pass the stipulated investment hurdle. They are not yet at the planning stage. For the nearer term in particular much depends on the ability of investors to take advantage of the current physical capacity of the supply chain to proceed with projects. The ability of the OGA to encourage the development of fields which require collaboration and the continued development and utilisation of common infrastructure will also have an important influence on the pace of new activity.

The development of the substantial numbers of new fields indicated above entails a worthwhile increase in investment expenditure over recent levels. In the near and medium term there is a reversal of the dramatic fall which has taken place over the past few years. In the context of the long-term behaviour of field investment the size of the upturn is not very large. The capacity of the supply chain to cater for the increased activity is generally available. The annual numbers of new field developments postulated are not large in relation to the long term levels. But, of course, there is a danger that costs may rise above the general inflation rate and endanger the viability of some new projects. Over the period 2018 – 2050 cumulative development expenditure is £124 billion at 2018 prices. This is not particularly large in relation to its long run behaviour. Over the long term future period to 2050 annual investment declines under the $60, 55 pence price case.

In this price case over the period to 2050 operating expenditures decline year by year in real terms. The cumulative expenditure 2018 – 2050 exceeds £147 billion at 2018 prices.

Similarly, field development plus operating expenditures (i.e. excluding decommissioning, exploration and appraisal) fall from recent levels throughout the period to 2050. Cumulative expenditure 2018 – 2050 is around £272 billion at 2018 prices.

Decommissioning expenditure increases at a substantial rate over the next decade and accumulates to nearly £53 billion at today's prices by 2050 by 2050. Around 86% of the total expenditure relates to currently sanctioned fields. Over the period 2018 – 2050 no less than 592 fields will either have been fully decommissioned or will be in the process of so doing. Of these over 51% relate to currently sanctioned fields.

When decommissioning costs are added to development and operating costs total field-related expenditures are around present levels for some years ahead. There is then a brisk decline to around £4 billion in 2050. The aggregate of the three elements indicate the claim on the resources of the supply chain or the related opportunities.

$70, 60 pence case

When the $70, 60 pence price scenario is considered there is found to be a significant increase in activity compared to the $60, 55 pence case. Thus over the period 2018 – 2050 no fewer than 529 fields developments are triggered compared to 421 in the $60, 55 pence case. Cumulative total hydrocarbon production is over 17 bn boe compared to 14.8 bn boe with the $60, 55 pence price case. It is noteworthy that the contribution from technical reserves becomes very substantial at 4.8 bn boe in the $70, 60 pence case. The risks attached to the achievement of this are clearly substantial.

Development expenditure in the $70, 60 pence scenario shows a significant increase over the next few years compared to present levels, but still remains far below the levels reached in the years prior to 2014. Over the whole period to 2050 there is a gentle long-term decline. Cumulative development expenditure is £158 billion at today's prices. This compares with around £124 billion under the $60, 55 pence price case.

Over the period to 2050 operating expenditures in real terms continue to decline at a modest pace with the $70, 60 pence price case, being noticeably less steep than in the lower price case. The cumulative total is £172 billion with the $70, 60 pence price case compared to £147 billion with the lower price case.

At the $70, 60 pence case development plus operating field expenditures (excluding decommissioning, exploration and appraisal) hold up at recent levels for a few years and then decline at a persistent, modest rate. Over the period to 2050 the cumulative total is nearly £330 billion at today's prices. This compared with £272 billion at the $60, 55 pence case.

At the $70, 60 pence case accumulated decommissioning expenditures to 2050 amount to £55.2 billion at today's prices. This compares with £52.6 billion with the lower price case. Over the period 2018 – 2050 no less than 668 fields will have been decommissioned or be in the process of doing so. Of the total 46% are currently sanctioned.

When decommissioning expenditures are added to development and operating costs the aggregate exceeds recent levels for a few years then declines at a modest but persistent rate to around £6 billion in 2050. The claim on the resources of the supply chain or the related opportunities remains very substantial.

The comparative effects of a higher hurdle rate of NPV/I > 0.5 were modelled and are given in the Appendix. With the $60, 55 pence price scenario cumulative total hydrocarbon production from 2018 to 2050 is 12.9 bn boe compared to 14.8 bn boe with the hurdle of NPV/I > 0.3. With the higher hurdle there are 321 new field developments compared to 460 with the lower hurdle. Over the period to 2050 cumulative field development expenditure is £95 billion with the higher hurdle compared to £124 billion with the lower hurdle. Cumulative operating expenditures are £133 billion with the higher hurdle compared to over £147 billion with the lower hurdle. Cumulative decommissioning expenditures are just over £50 billion with the higher hurdle compared to nearly £53 billion with the lower hurdle.

With the $70, 60 pence price case cumulative hydrocarbon production from 2018 to 2050 becomes 15.6 bn boe compared to just over 17 bn boe at the lower hurdle. Over the period to 2050 460 new field developments are triggered with the high threshold requirement compared to 529 new developments with the lower hurdle. Cumulative field development expenditure is £133.3 bn at the higher hurdle compared to £158 bn with the lower threshold return. Operating expenditure accumulate to £159 bn with the higher threshold compared to £172 bn with the lower hurdle. Cumulative decommissioning expenditures are £53.3 bn with the higher hurdle compared to £55.2 bn with the lower one. Significantly fewer fields in the category of technical reserves are developed at the higher hurdle compared to the lower one.

The overall conclusions are that in current circumstances the remaining potential in the UKCS is very substantial. The production targets of Vision 2035 can be achieved. The important caveats are that the benefits of (1) the painfully-achieved cost reductions, and (2) the productivity gains from enhanced production efficiency have to be maintained. Technical progress such as through the efforts of the OGTC and OGIC, with their industrial and academic partners can help to ensure that productivity improvements offset cost increases. As noted above the OGA has a major role to play through facilitating co-operation among licensees and thus producing economies of scale via cluster developments and extended use of common infrastructure. A return to the rampant cost inflation such as was experienced in the period 2009 – 2014 would certainly jeopardise the attainment of the results reported in this study.

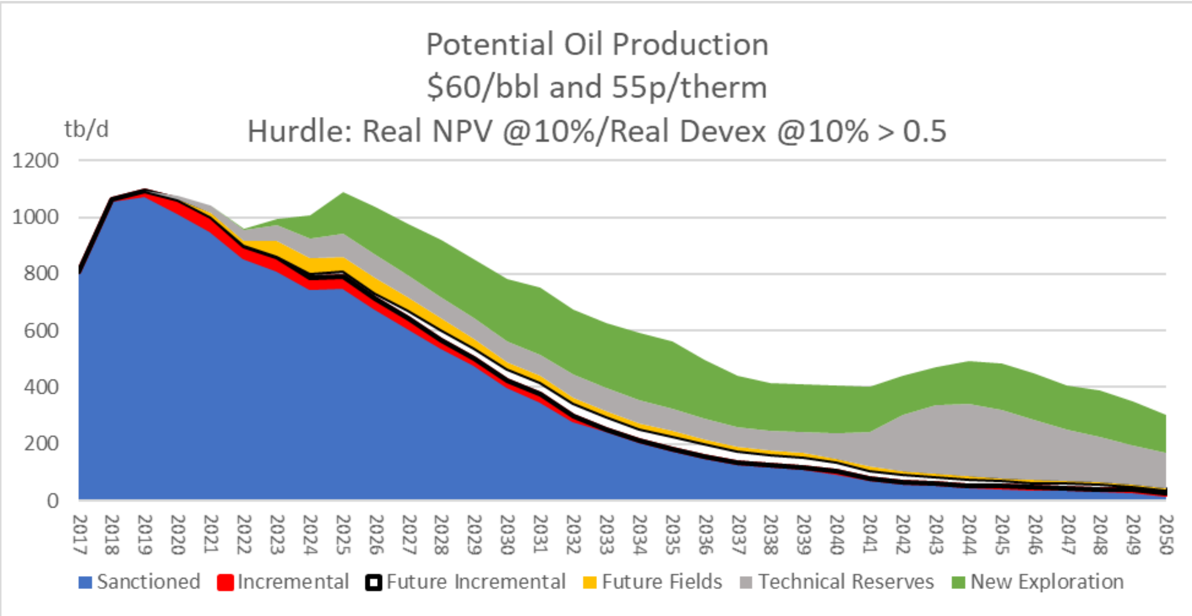
<u>**Appendix**</u>

In this Appendix the prospects for production and expenditure are shown when the investment hurdle is NPV/I > 0.5

a) Potential Production

In Chart A1 potential oil production over the period to 2018 to 2050 is shown for the $60, 55 pence case.

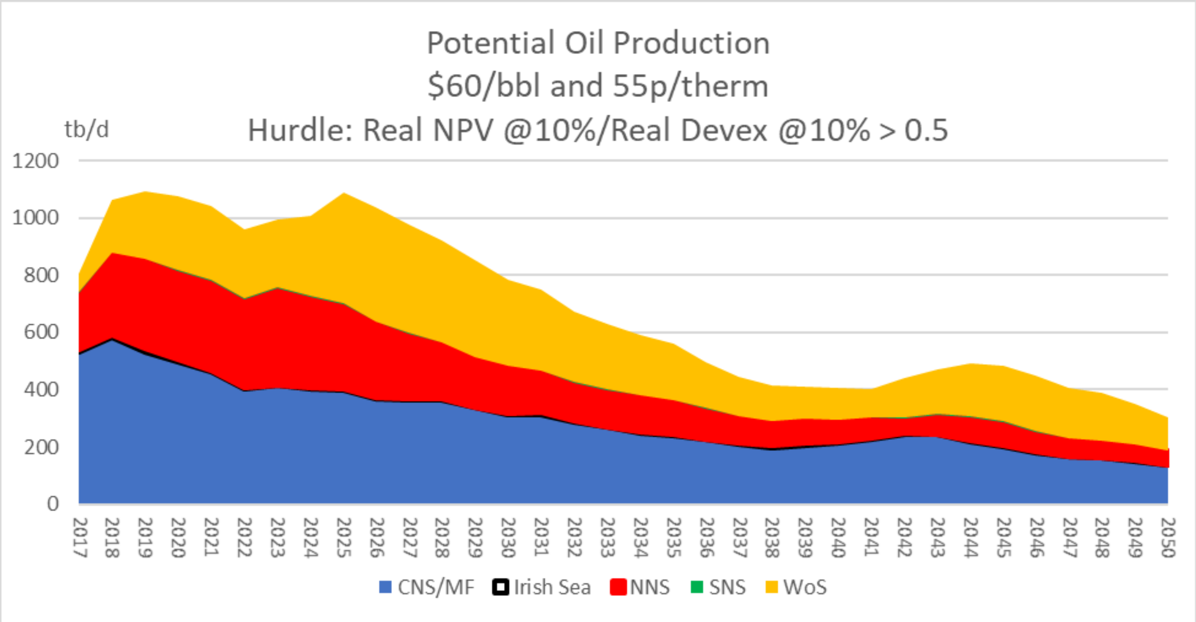
Chart A1



Over the period cumulative oil production is 8,192 million barrels of which 4,539 million comes from sanctioned fields, 155 million from current incremental projects, 316 million from future incremental projects, 215 million from probable and possible fields, 1,214 million from technical reserves, and 1,752 million from future discoveries.

Chart A2 gives the same information on a geographic basis.

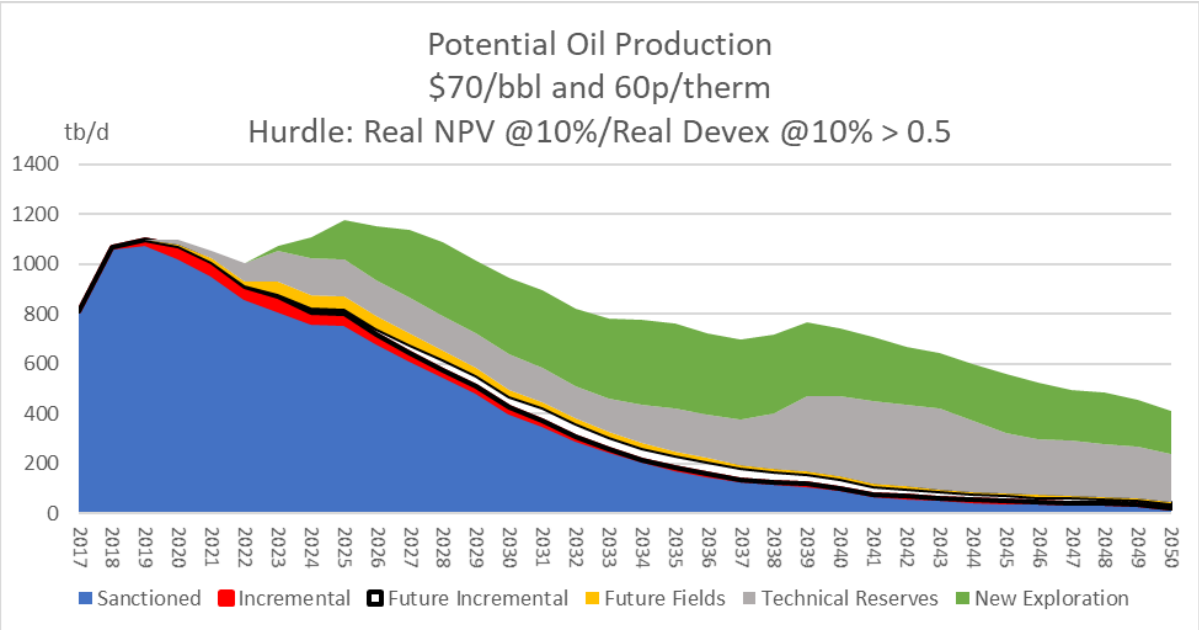
Chart A2



It is seen that 3,552 million barrels comes from the CNS/MF area followed by 2,631million barrels coming from the WoS and 1,937 million barrels coming from the NNS.

In Chart A3 potential oil production over the period 2018 to 2050 is shown for the $70, 60 pence case.

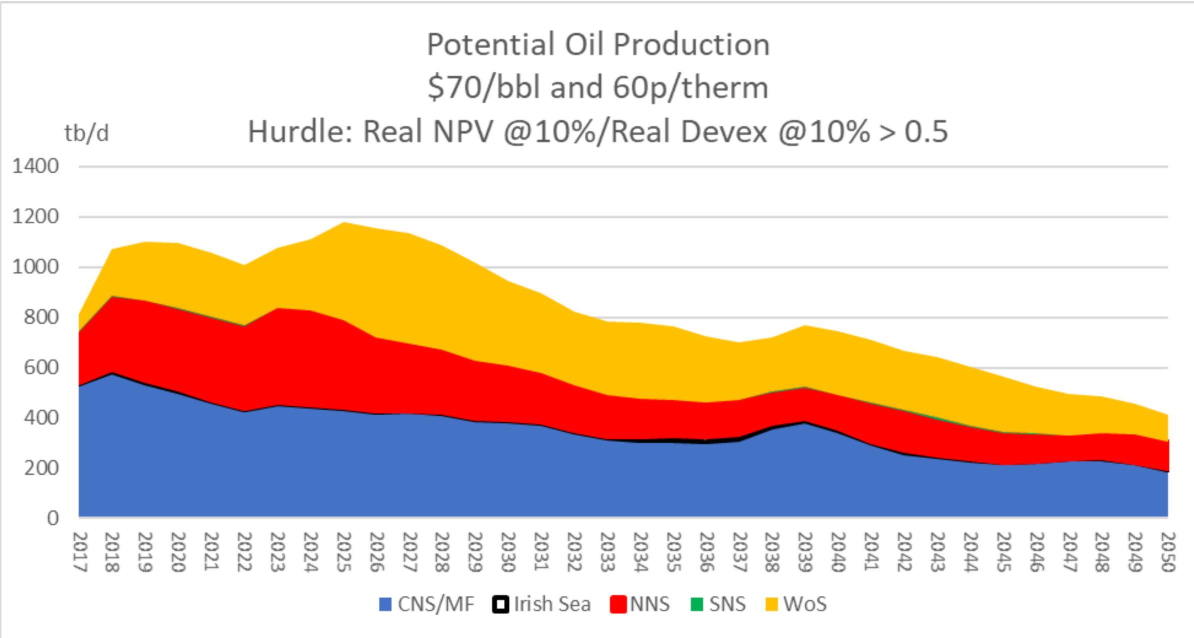
Chart A3



Over the period cumulative oil production is just over 9,957 million barrels of which 4,580 million comes from sanctioned fields, 169 million from current incremental projects, 346 million from future incremental projects, 215 million from probable and possible fields, 2,101 million from technical reserves, and 2,545 million from future discoveries.

Chart A4 gives the same information on a geographic basis.

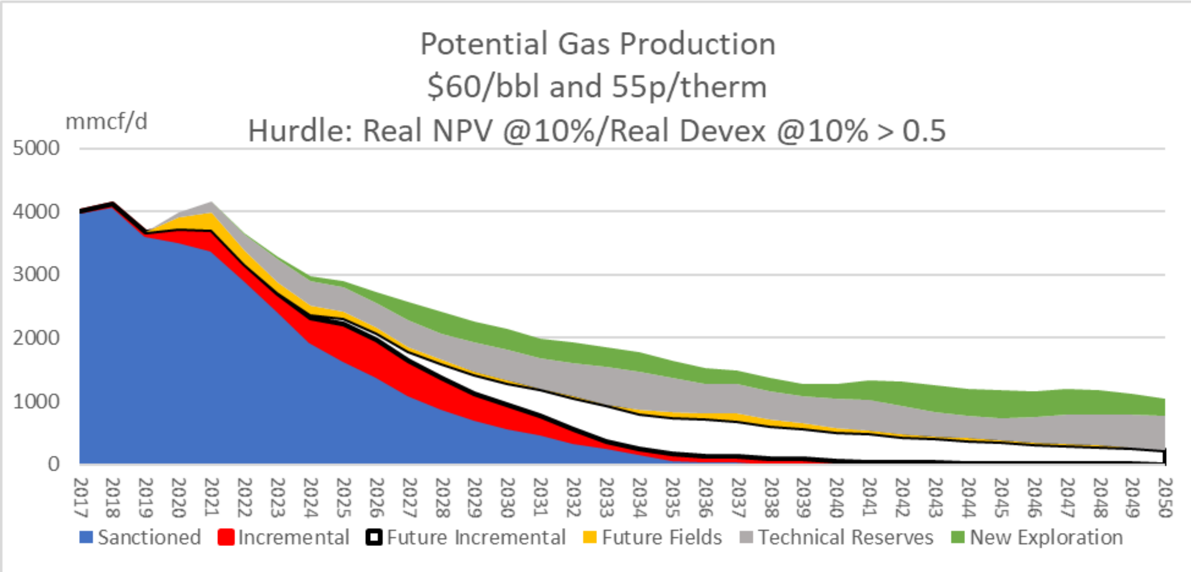
Chart A4



It is seen that 4,261 million barrels comes from the CNS/MF area followed by 3,174 million barrels coming from the WoS and 2,411 million barrels coming from the NNS.

In Chart A5 potential gas production over the period 2018 to 2050 is shown for the $60, 55 pence case.

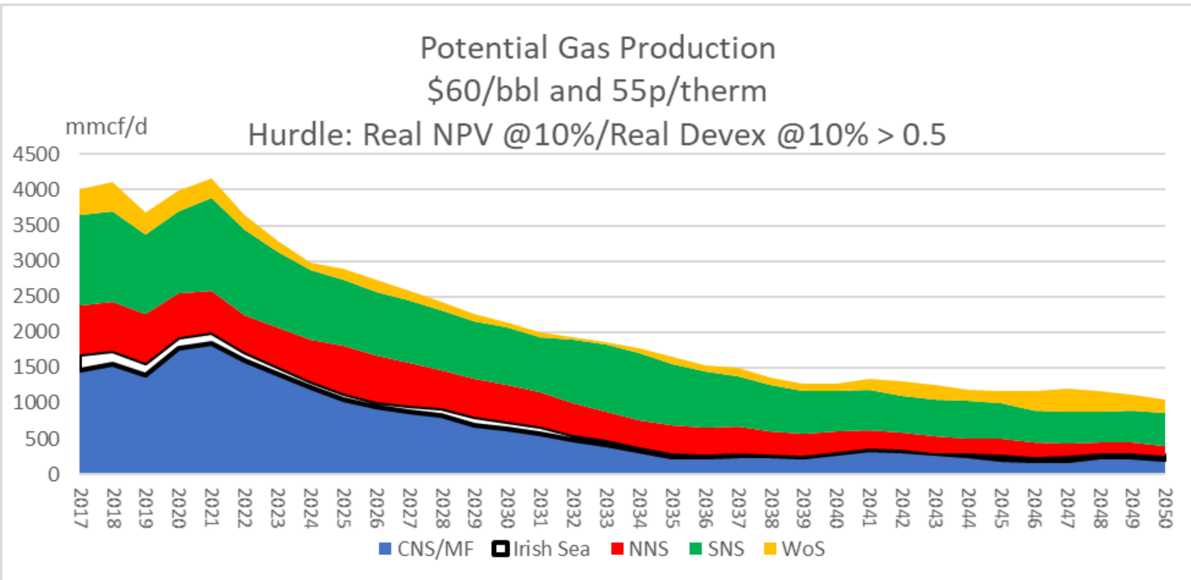
Chart A5



Over the period cumulative gas production is just under 4,490 million barrels of oil equivalent of which 1,963 mmboe comes from sanctioned fields, 343 mmboe from current incremental projects, 649 mmboe from future incremental projects, 137 mmboe from probable and possible fields, 863 mmboe from technical reserves, and 535 mmboe from future discoveries.

Chart A6 gives the same information on a geographic basis.

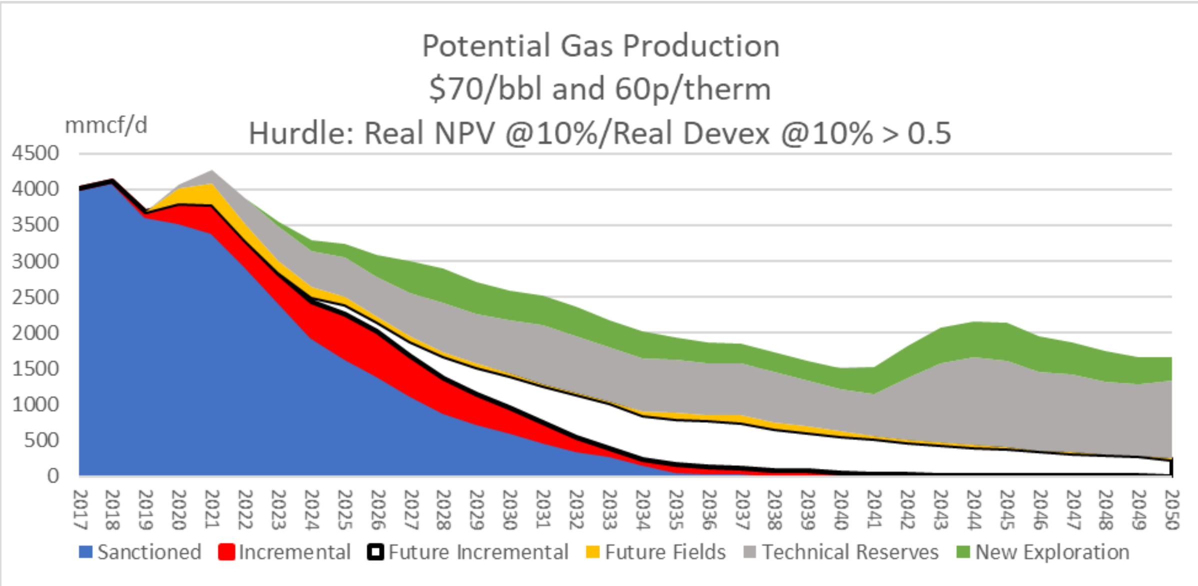
Chart A6



It is seen that 1,684 mmboe comes from the SNS area, 1,408 mmboe comes from the CNS/MF area followed by 882 mmboe coming from the NNS, 358 mmboe comes from the WoS area and 158 million barrels coming from the Irish Sea.

In Chart A7 potential gas production over the period 2018 to 2050 is shown for the $70, 60 pence case.

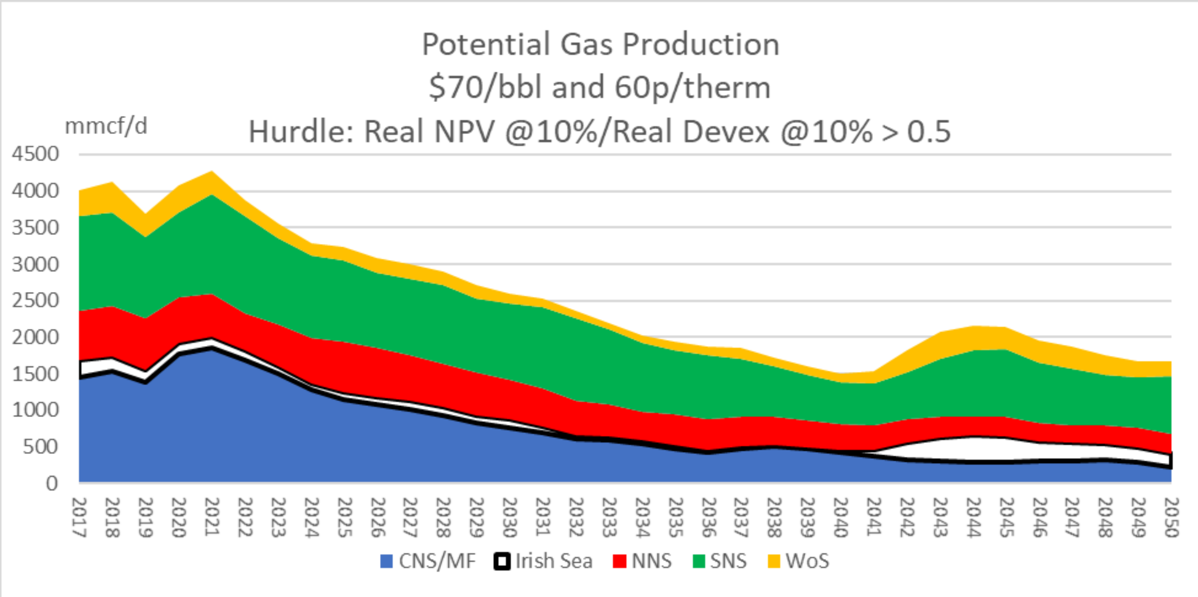
Chart A7



Over the period cumulative gas production is just over 5,376 million barrels of oil equivalent of which 1,972 mmboe comes from sanctioned fields, 380 mmboe from current incremental projects, 727 mmboe from future incremental projects, 143 mmboe from probable and possible fields, 1,487 mmboe from technical reserves, and 667 mmboe from future discoveries.

Chart A8 gives the same information on a geographic basis.

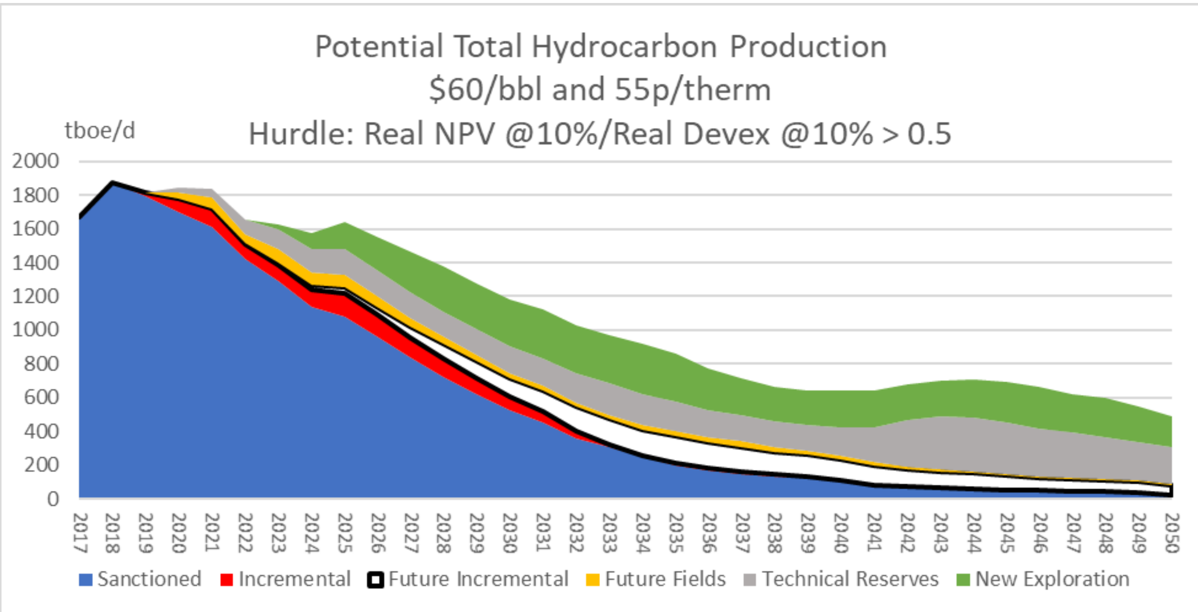
Chart A8



It is seen that 2,024 mmboe comes from the SNS area, 1,635 mmboe comes from the CNS/MF area followed by 969 mmboe coming from the NNS, 454 mmboe comes from the WoS area, and 294 mmboe coming from the Irish Sea.

In Chart A9 potential total hydrocarbon production over the period 2018 to 2050 is shown for the $60, 55 pence case.

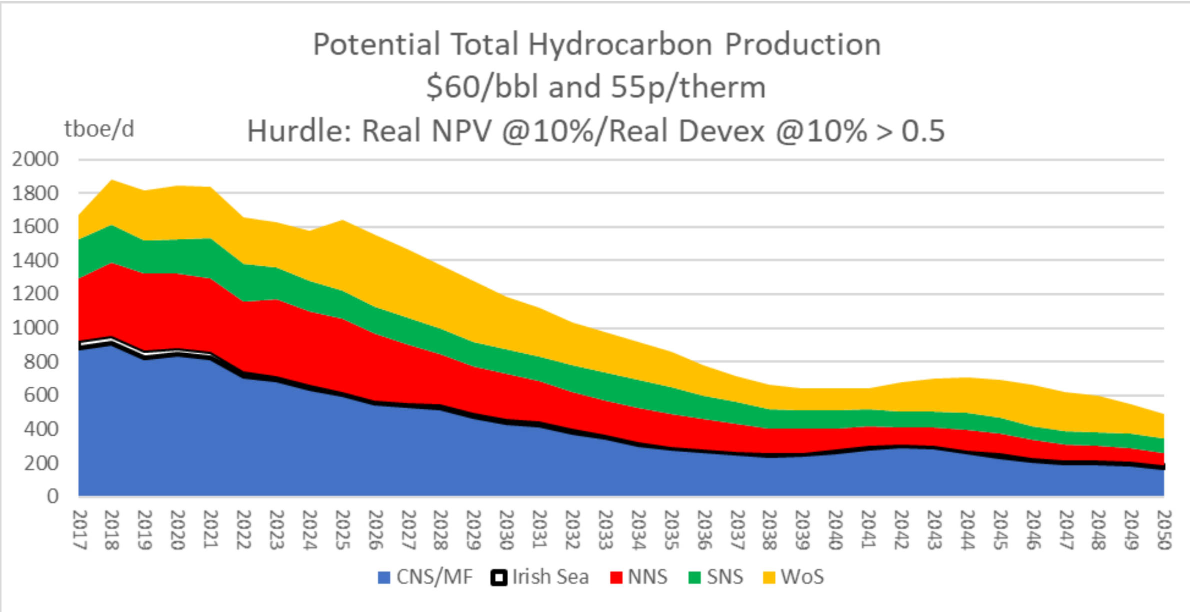
Chart A9



Over the period total hydrocarbon production is just under 12,924 million barrels of oil equivalent of which 6,685 mmboe comes from sanctioned fields, 515 mmboe from current incremental projects, 1,001 mmboe from future incremental projects, 353 mmboe from probable and possible fields, 2,079 mmboe from technical reserves, and 2,290 mmboe from future discoveries.

Chart A10 gives the same information on a geographic basis.

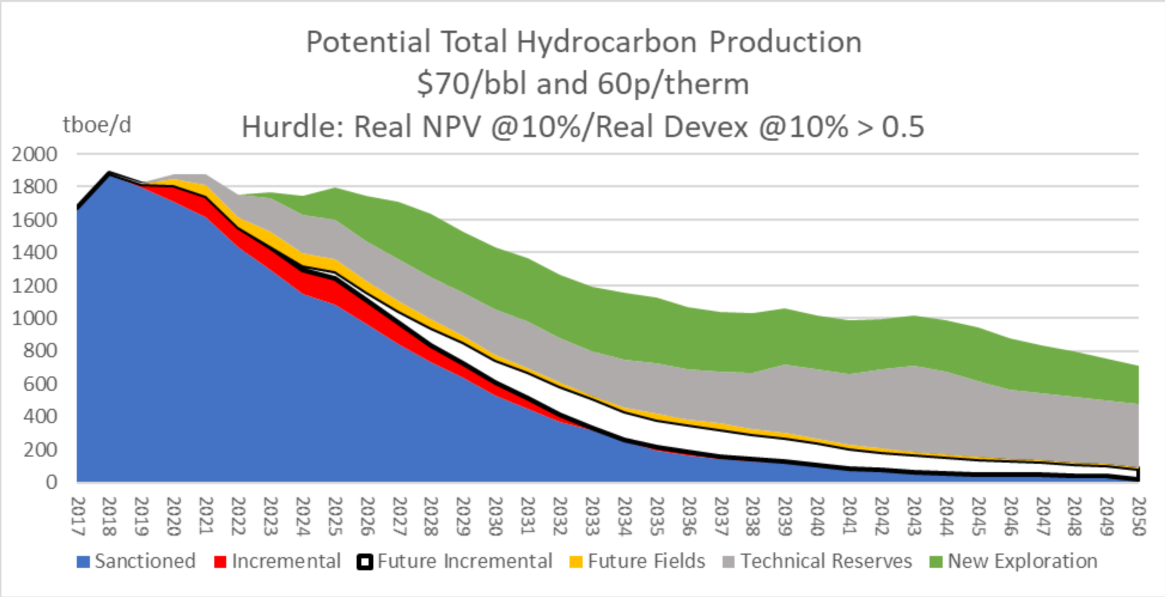
Chart A10



It is seen that 5,114 mmboe comes from the CNS/MF area, 2,995 mmboe comes from the WoS area followed by 2,892 mmboe coming from the NNS, 1,712 mmboe comes from the SNS area, and 210 mmboe coming from the Irish Sea.

In Chart A11 potential total hydrocarbon production over the period 2018 to 2050 is shown for the $70, 60 pence case.

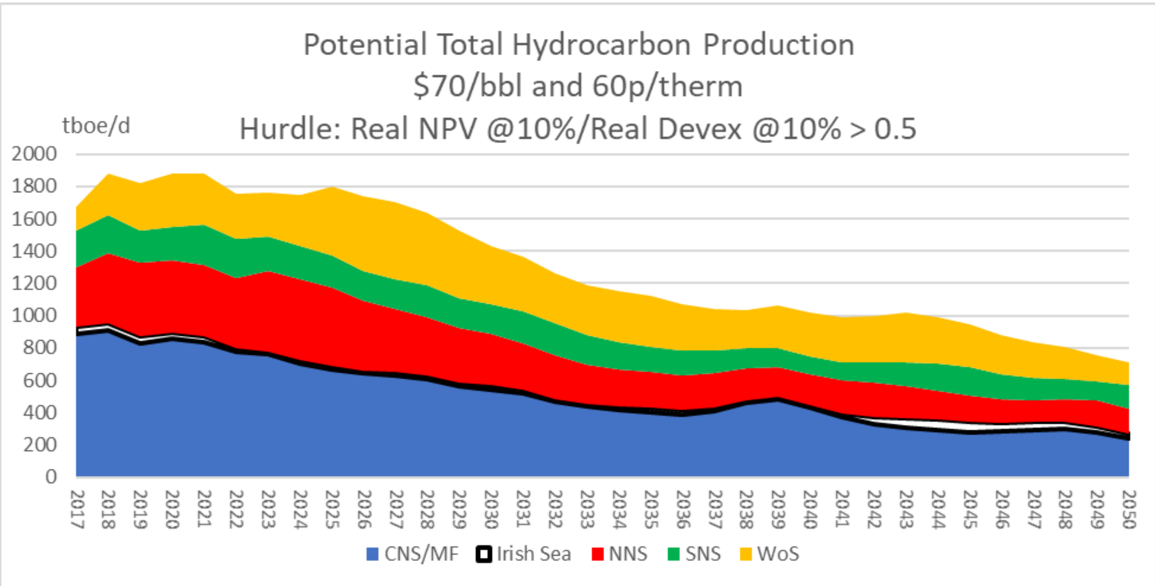
Chart A11



Over the period total hydrocarbon production is just over 15,630 million barrels of oil equivalent of which 6,736 mmboe comes from sanctioned fields, 584 mmboe from current incremental projects, 1,144 mmboe from future incremental projects, 359 mmboe from probable and possible fields, 3,593 mmboe from technical reserves, and 3,215 mmboe from future discoveries.

Chart A12 gives the same information on a geographic basis.

Chart A12

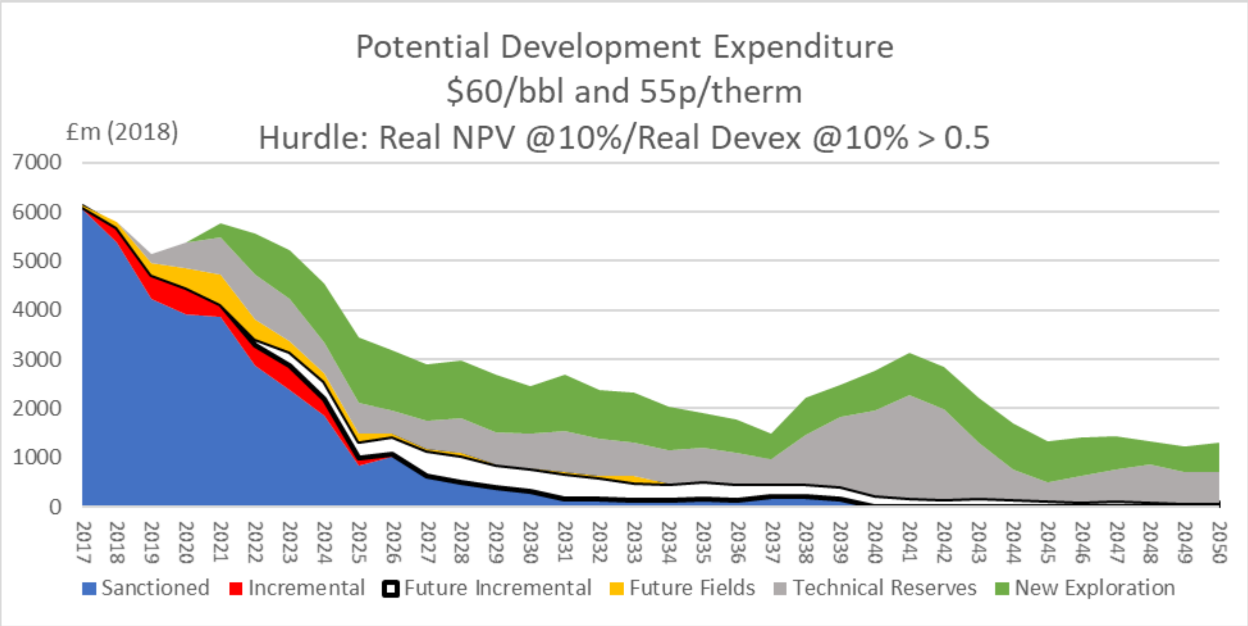


It is seen that 6,101 mmboe comes from the CNS/MF area, 3,636 mmboe comes from the WoS area followed by 3,454 mmboe coming from the NNS, 2,064 mmboe comes from the SNS area, and 376 mmboe coming from the Irish Sea.

b) Potential Development Expenditure

Potential development expenditure is shown in Chart A13 for the $60, 55 pence case.

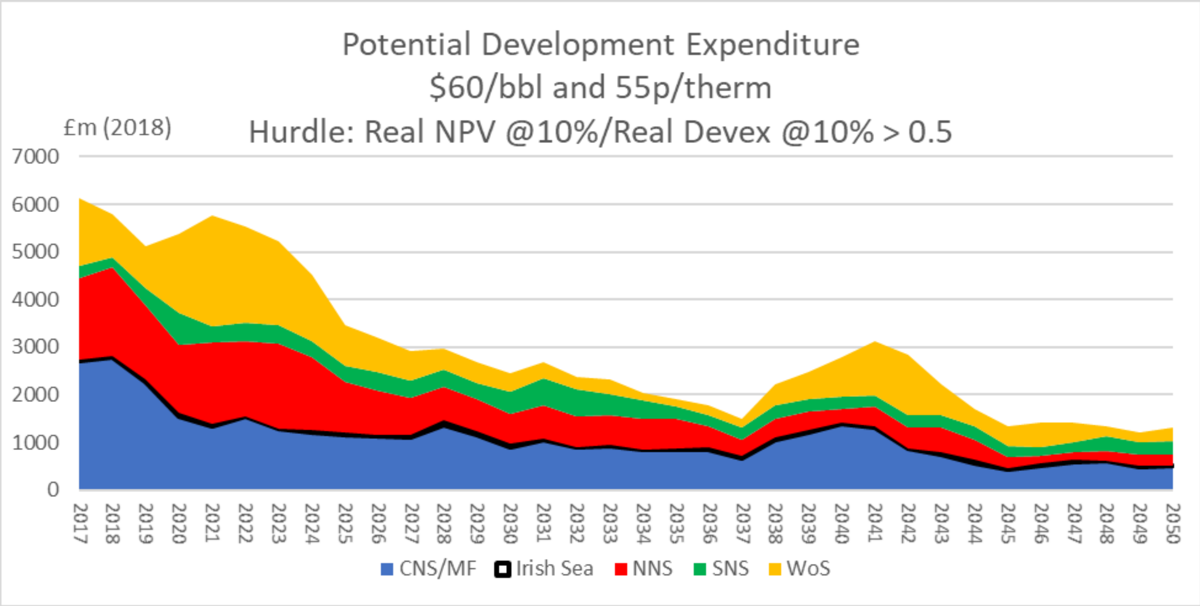
Chart A13



Over the period 2018 to 2050 total development expenditure is just over £95,005 million at 2018 prices. The sanctioned fields contribute £29,547 million by 2040. Current incremental projects contribute £3,159 million by 2032 and future incremental projects contribute £8,212 million. The probable and possible fields contribute £2,531 million whilst the technical reserves contribute £25,616 million and the future discoveries contribute £25,940 million.

Chart A14 gives the same information on a geographic basis.

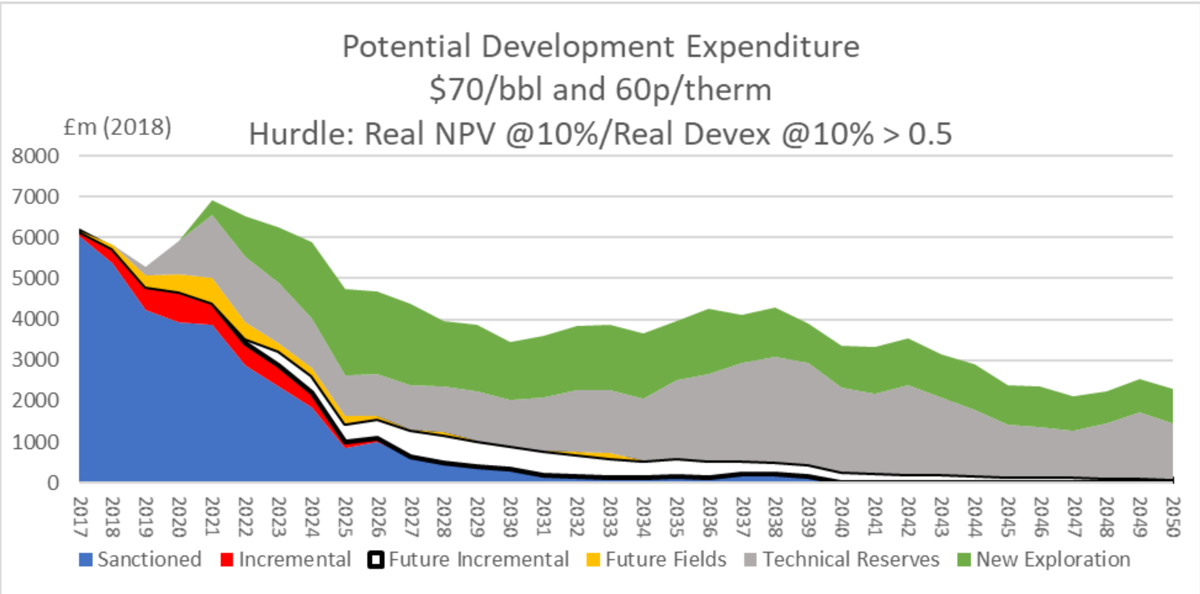
Chart A14



Development expenditure in the CNS/MF area is £35,185 million, in the NNS it is £24,263 million, in the WoS area it is £23,345 million, in the SNS area it is £10,892 million and in the Irish Sea it is £1,320 million.

Potential development expenditure is shown in Chart A15 for the $70, 60 pence case.

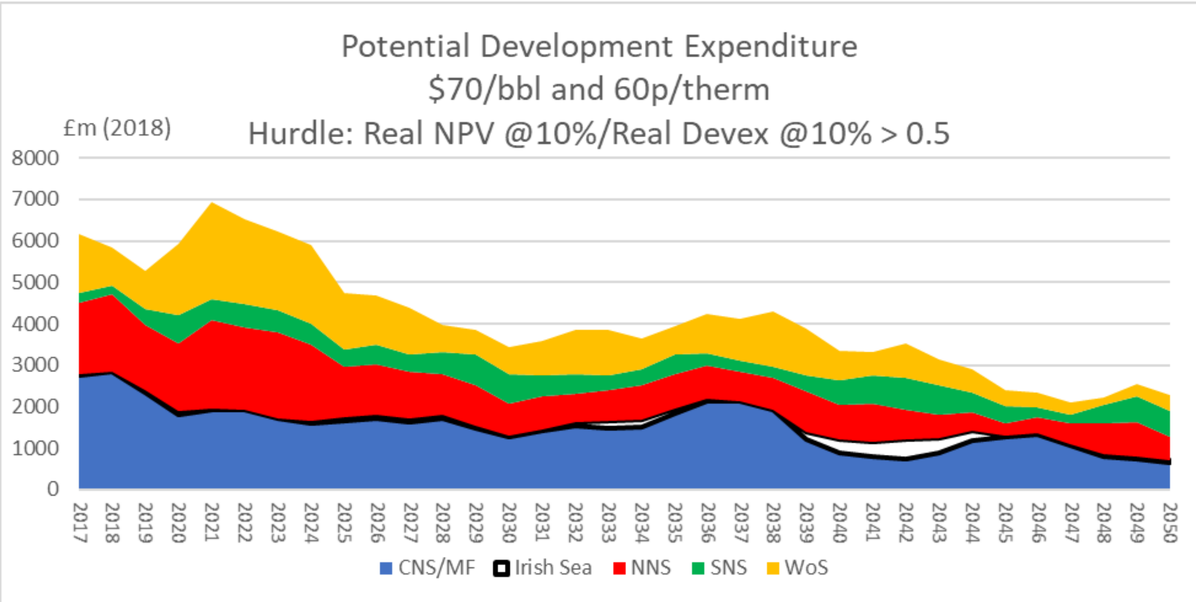
Chart A15



Over the period 2018 to 2050 total development expenditure is just over £133,271 million at 2018 prices. The sanctioned fields contribute £29,552 million by 2040. Current incremental projects contribute £3,943 million by 2032 and future incremental projects contribute £10,220 million. The probable and possible fields contribute £2,608 million whilst the technical reserves contribute £48,284 million and the future discoveries contribute £38,664 million.

Chart A16 gives the same information on a geographic basis.

Chart A16

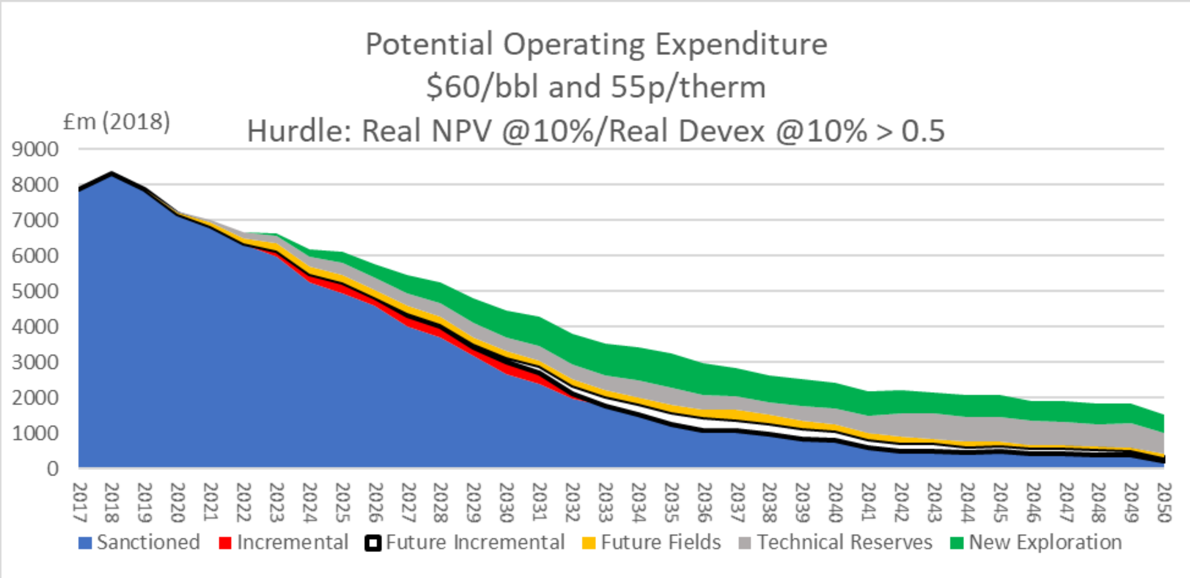


Development expenditure in the CNS/MF area is £49,161 million, in the NNS it is £33,352 million, in the WoS area it is £31,468 million, in the SNS area it is £15,759 million, and in the Irish Sea it is £3,531 million.

c) Potential Operating Expenditure

Potential operating expenditure is shown in Chart A17 for the $60, 55 pence case.

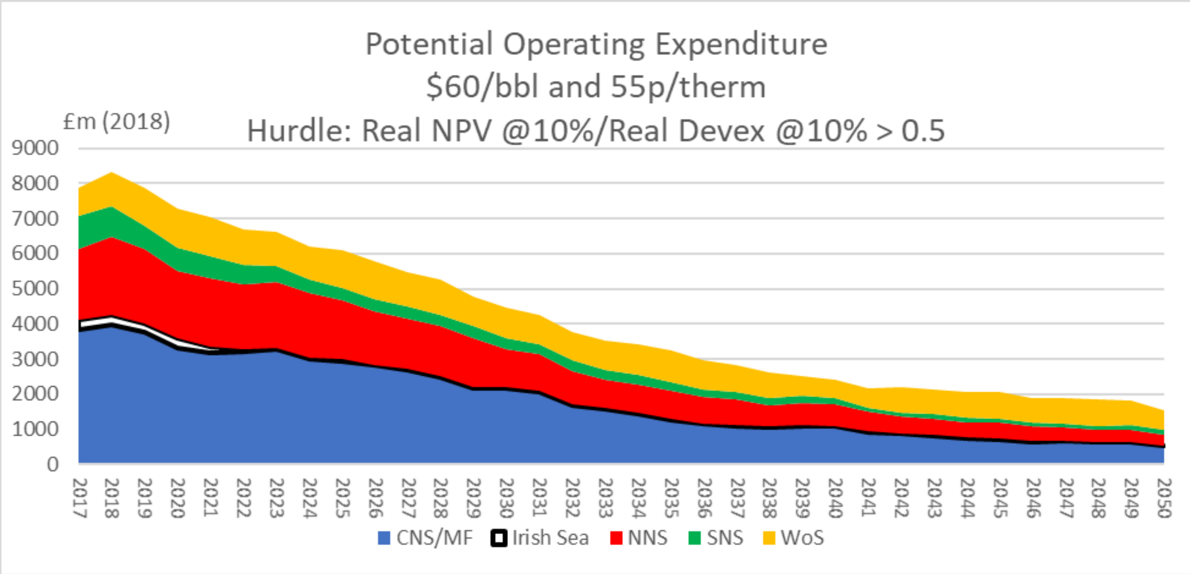
Chart A17



Over the period 2018 to 2050 total operating expenditure is just under £133,101 million at 2018 prices. The sanctioned fields contribute £88,438 million. Current incremental projects contribute £2,827 million and future incremental projects contribute £5,283 million. The probable and possible fields contribute £4,918 million whilst the technical reserves contribute £13,755 million, and the future discoveries contribute £17,880 million.

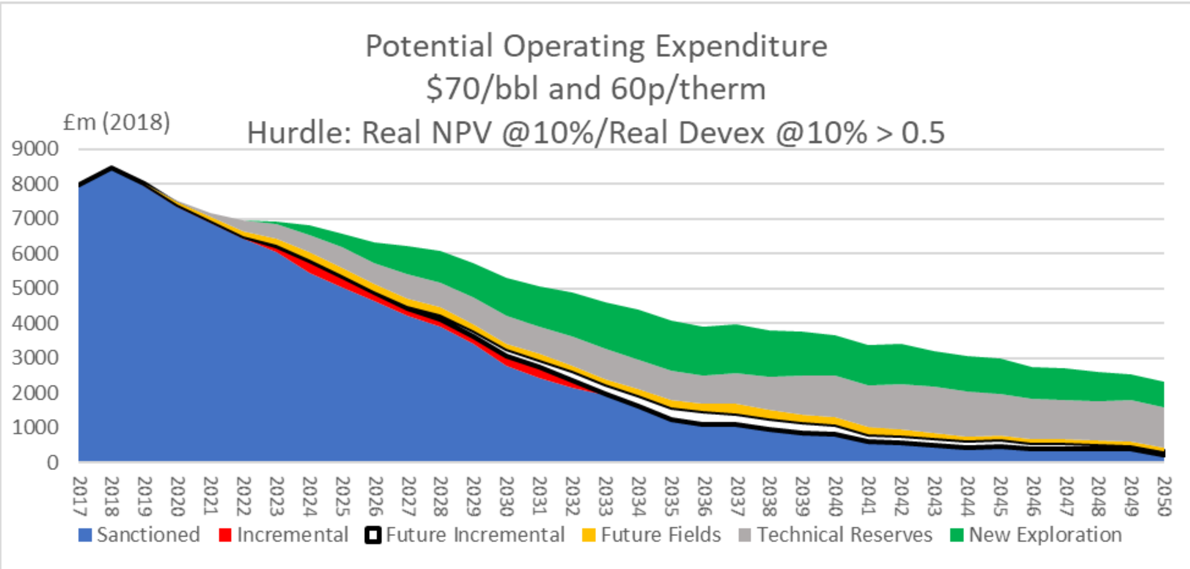
Chart A18 gives the same information on a geographic basis.

Chart A18



Potential operating expenditure is shown in Chart A19 for the $70, 60 pence case.

Chart A19

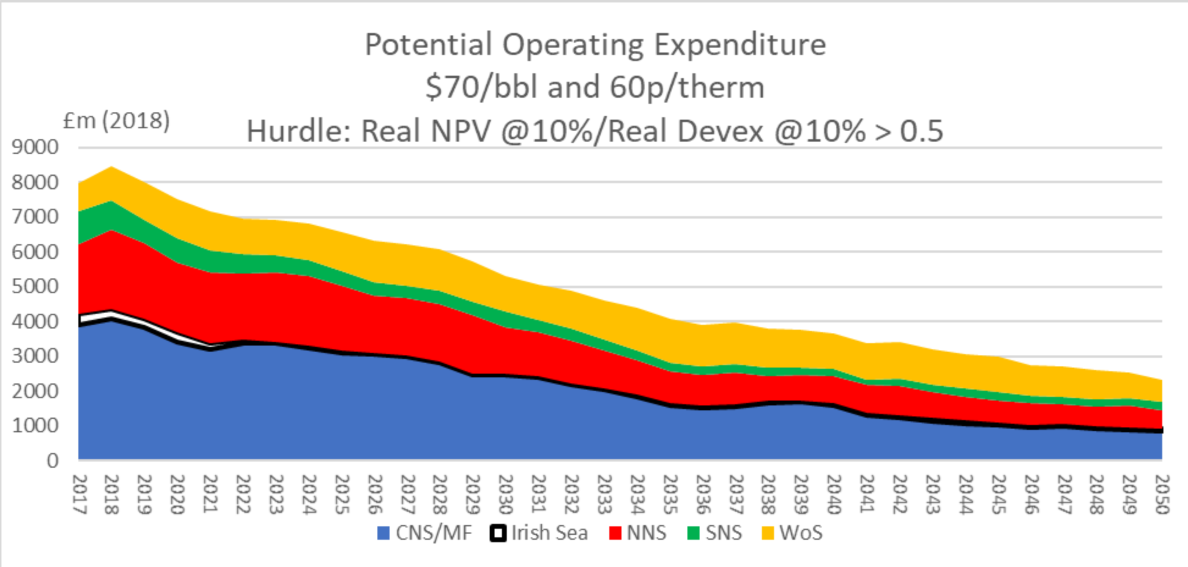


Over the period 2018 to 2050 total operating expenditure is just over £158,860 million at 2018 prices. The sanctioned fields contribute £90,820 million. Current incremental projects contribute £2,935 million and future incremental projects contribute £5,596 million. The probable and possible fields contribute

£4,968 million, whilst the technical reserves contribute £26,876 million and the future discoveries contribute £27,665 million.

Chart A20 gives the same information on a geographical basis.

Chart A20

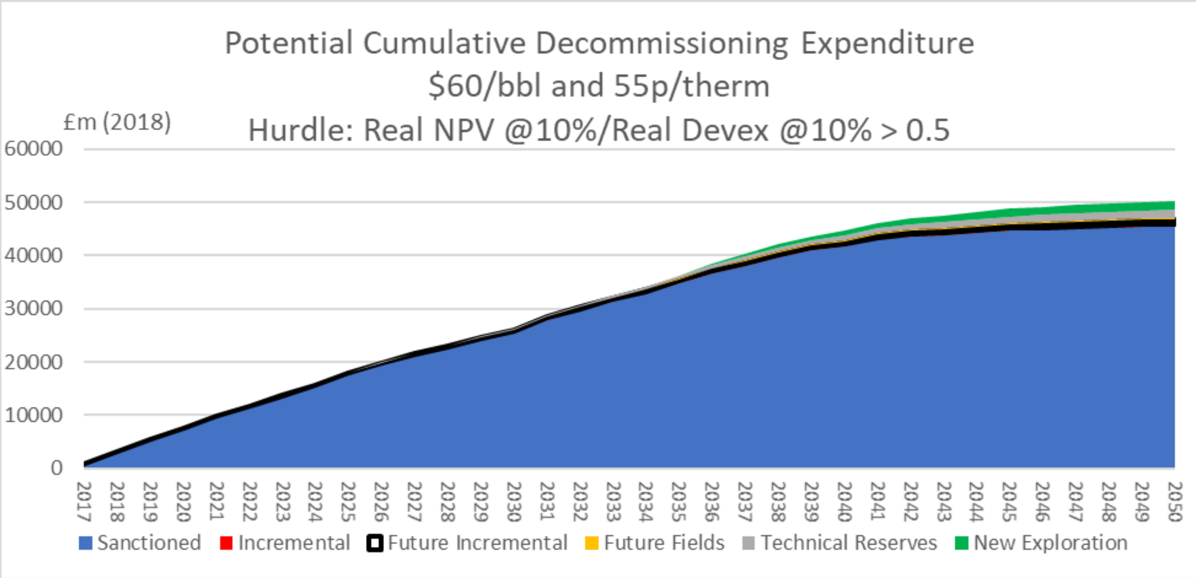


Operating expenditure in the CNS/MF area is £69,691 million, in the NNS it is £40,282 million, in the WoS area it is £34,726 million, in the SNS area it is £11,508 million, and in the Irish Sea it is £2,653 million.

d) Potential Decommissioning Activity

Chart A21 shows cumulative decommissioning expenditures for the $60, 55 pence case.

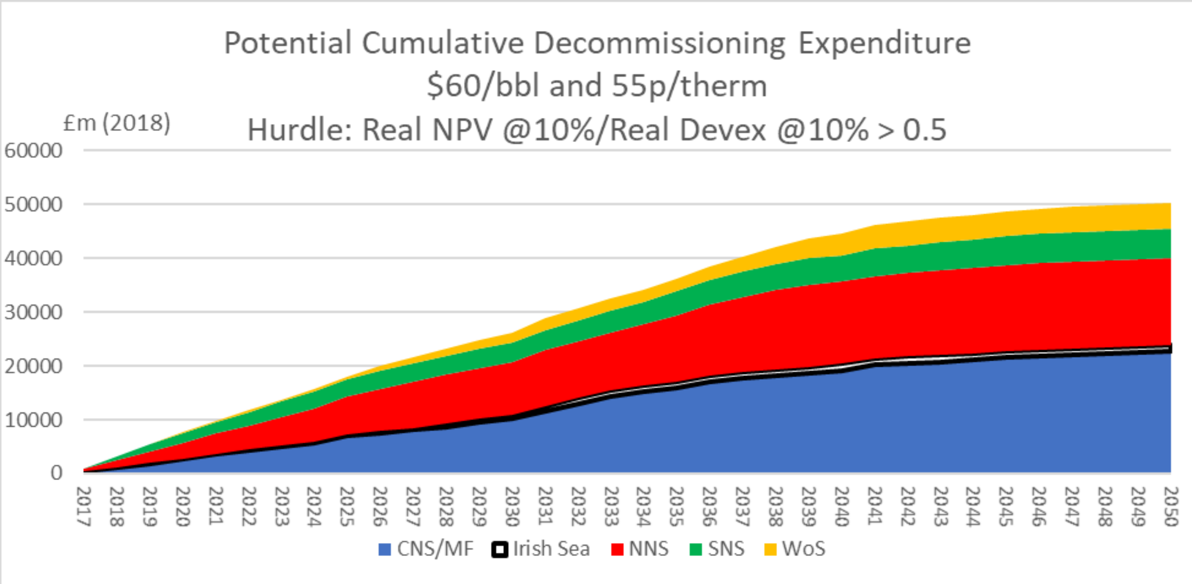
Chart A21



Cumulative decommissioning costs could be just over £50,315 million by 2050, with 90% coming from the already sanctioned fields. They account for £45,407 million, current incremental projects account for £438 million, future incremental projects account for £935 million, probable and possible fields account for £266 million, technical reserve fields account for £1,545 million, and future new exploration finds account for £1,724 million. 52% of the decommissioning spend will have been incurred by 2030 and 72% by 2035.

Chart A22 gives the same information on a geographic basis.

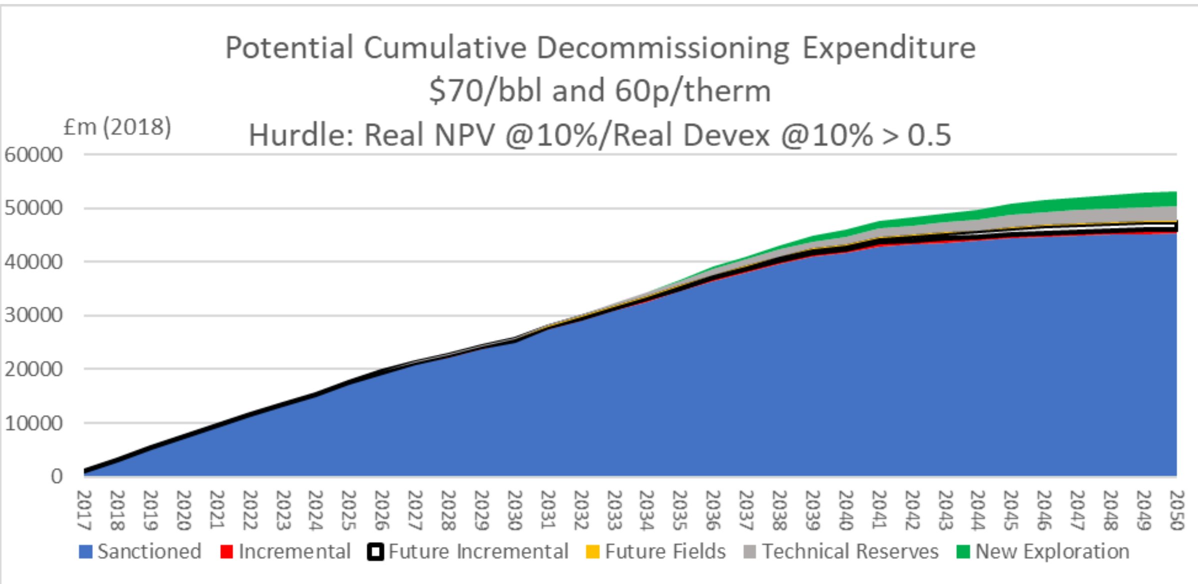
Chart A22



Decommissioning expenditure in the CNS/MF area is £22,659 million which is 45% of the total spend. In the NNS it is £16,209 million which is over 32% of the spend. In the WoS area it is £4,700 million, in the SNS area it is £5,534 million, and in the Irish Sea it is £1,213 million.

Chart A23 shows the cumulative decommissioning costs for the $70, 60 pence case.

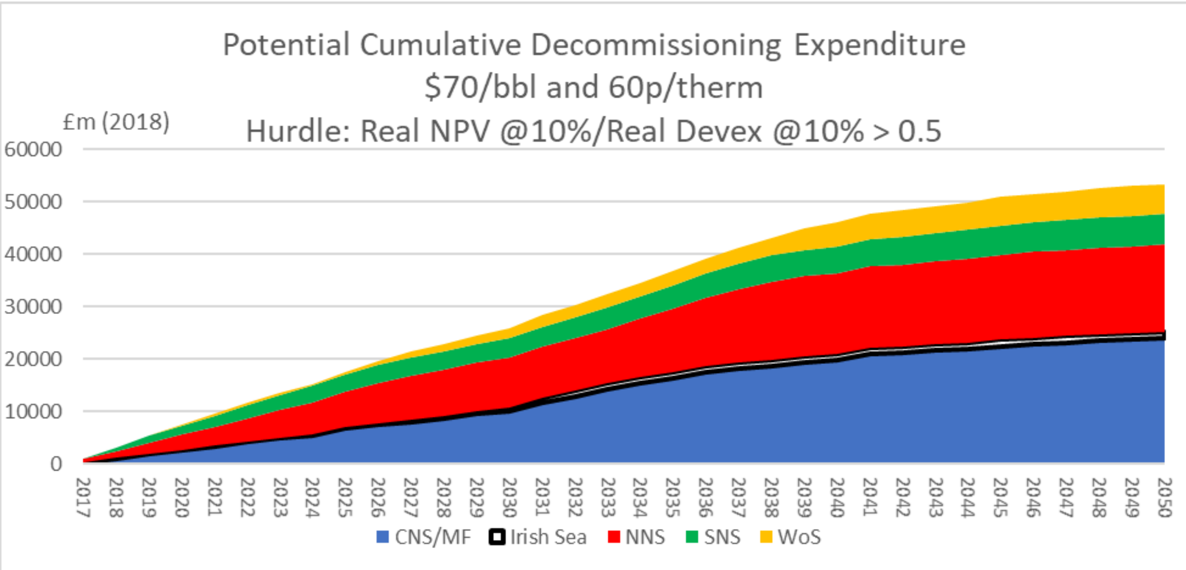
Chart A23



Cumulative decommissioning costs could be just over £53,282 million by 2050, with 85% coming from the already sanctioned fields. The sanctioned fields account for £45,339 million, current incremental projects £770 million, future incremental projects £1,368 million, probable and possible fields £278 million, technical reserve fields account for £2,783 million, and new exploration finds £2,745 million. 53% of the decommissioning spend will have been incurred by 2031, and 73% will have been incurred by 2036.

Chart A24 gives the same information on a geographic basis.

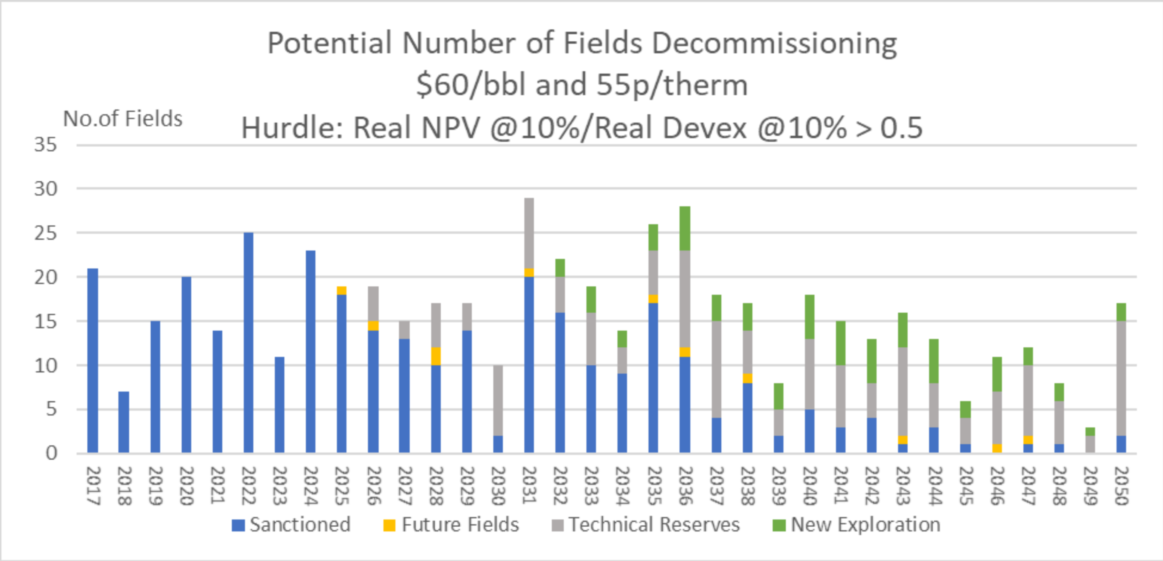
Chart 72



Decommissioning expenditure in the CNS/MF area is £23,927 million which is 45% of the total spend. In the NNS it is £16,646 million which is 31% of the spend. In the WoS area it is £5,685 million, in the SNS area it is £5,746 million, and in the Irish Sea it is £1,279 million.

Decommissioning expenditure is spread over many years for most fields and Chart A25 shows the number of fields decommissioning for the $60, 55 pence case.

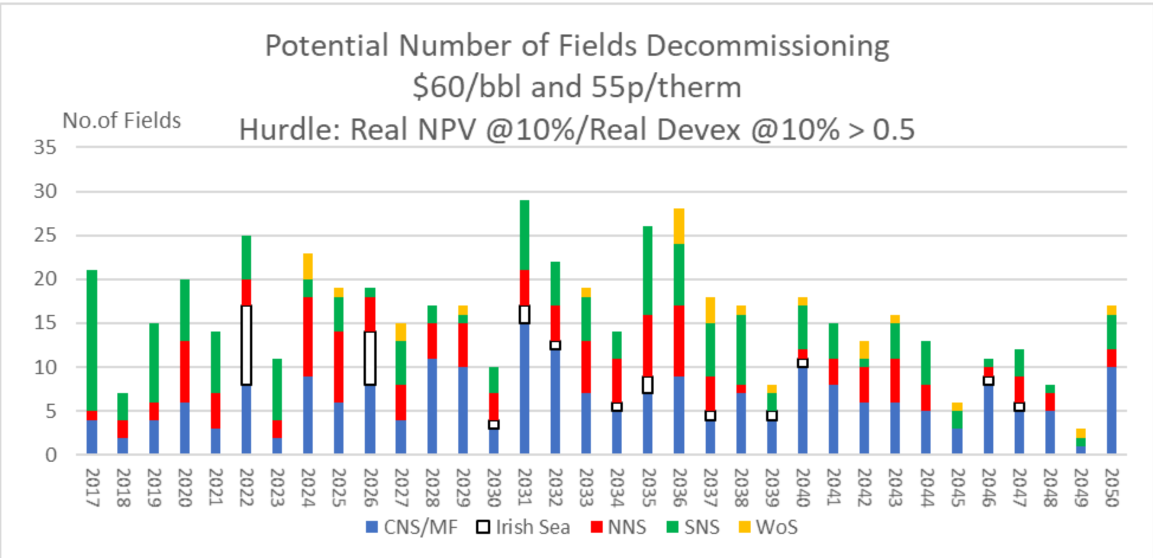
Chart A25



By 2030 there will be 212 fields having completed or be engaged in decommissioning. By 2035 322 fields will have completed or be engaged in decommissioning, and by 2050 there could be 525 fields having completed or be engaged in decommissioning. By 2050 there will be 304 sanctioned fields, 11 probable or possible fields, 149 technical reserve fields, and 61 future exploration finds having completed or be engaged in decommissioning.

Chart A26 gives the same information on a geographic basis.

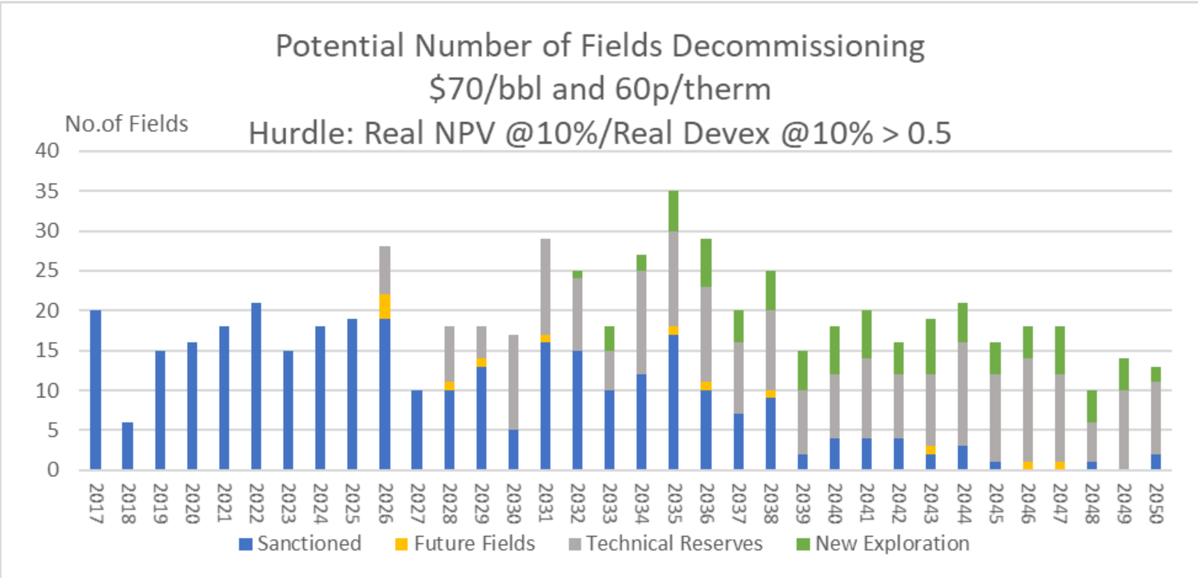
Chart A26



By 2030 there will be 76 CNS/MF fields, 56 SNS fields, 57 NNS fields, 16 Irish Sea fields and 7 WoS fields having completed or be engaged in decommissioning. By 2050 there will be 213 CNS/MF fields, 141 SNS fields, 120 NNS fields, 27 Irish Sea fields, and 24 WoS fields having completed or be engaged in decommissioning.

Chart A27 shows the number of fields decommissioning for the $70, 60 pence case.

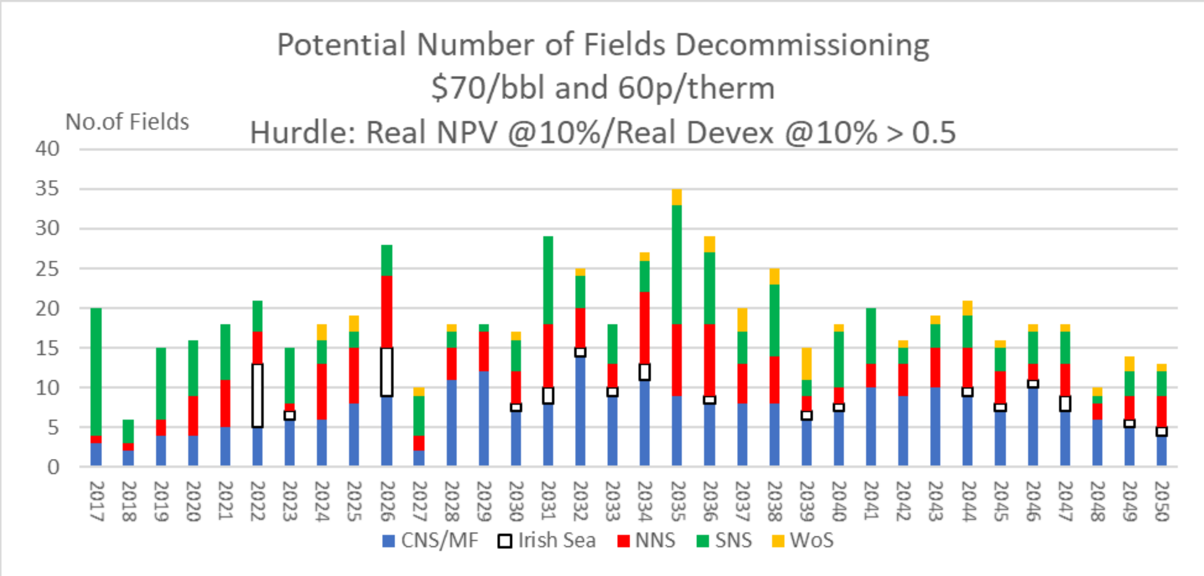
Chart A27



By 2030 there will be 219 fields having completed or be engaged in decommissioning. By 2035 there will be 353 fields having completed or be engaged in decommissioning and by 2050 there could be 625 fields having completed or be engaged in decommissioning. By 2050 there will be 304 sanctioned fields, 12 probable or possible fields, 226 technical reserve fields and 83 future exploration finds having completed or be engaged in decommissioning.

Chart A28 gives the same information on a geographic basis.

Chart A28



By 2030 81 CNS/MF fields, 58 SNS fields, 57 NNS fields, 16 Irish Sea fields and 7 WoS fields will have completed or be engaged in decommissioning. By 2050 246 CNS/MF fields, 162 SNS fields, 151 NNS fields, 32 Irish Sea fields, and 34 WoS fields will have completed or be engaged in decommissioning.